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MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME 58

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MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVIII NUMBER 1

JANUARY-FEBRUARY 1970

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From the Director

MOST PEOPLE are alarmed about the vanishing wilderness. I am of course concerned about our natural areas, but I am concerned also with our vanishing urban parks and greenbelts. St. Louis is a fortunate city with its many tree lined streets and beautiful parks. Not all cities are so green, and St. Louis is cooler because of the trees, and has more shade and less wind.

A healthy city is a green city. Plants filter the air and supply the oxygen we breathe. A city of only asphalt and pavement, of sewers and skyscrapers, of freeways and parking lots is a sick city. Man must learn to merge country and city and to integrate greenbelts with residence and business. European cities are tree lined and dotted with parks. By tradition the European understands the need for urban parks, for Tivoli, and for botanical gardens.

We need the right kinds of trees and shrubs for the city. Not all plants will grow in the summer heat reflected from parking lots and buildings. Not every tree will tolerate the masses of salt splashed from the streets in winter into the soil around their roots. Nor is it easy for plants to breathe the chemical laden urban air and remain healthy.

We need to plan the proper plants for the city and to cultivate them especially for this purpose. We need to integrate the country with the city and get some of nature back into the urban area. Birds and animals will live with us in the city if we give them the proper habitats, such as cover for quail in our parks, fruit trees for waxwings in our yards, shrubs with seeds for cardinals, and insects for the warblers that migrate through in the spring and autumn.

David M. Gates.

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Cover design by Peter Geist.
Illustration is from a woodcut of the herb horehound *(Labiatae marrubium)* in John Parkinson's *Theatrum Botanicum* published in London, 1640.

GARDENING IN ST. LOUIS

JANUARY—FEBRUARY

THE POST-HOLIDAY season is garden catalog time. These colorful books inspire one with the promise of perfect plants and ideal blooms. It pays to read seed catalogs carefully and repeatedly. They contain much sound horticultural information. Plan your 1970 garden on paper for best results. A garden log or notebook that records plantings and their success or failure can be of great help.

Order seeds and plants early to get the best selection. It won't be long before the bleak winter weather is once again behind us. Seeds of many wild flowers and hardy perennials like phlox and columbine may be sown in the cold frame. If you like to sow seeds, you probably experiment a bit with containers. Have you ever tried the water-proof fiber containers called by the trade-name, "Market Pack"? They are available in at least a half dozen different sizes and may be obtained from nurseries and seed stores.

Keep feeding the birds and provide them with water. They'll crowd around for suet, seed, peanut butter, and fruit.

Water shrubs if the ground is dry and unfrozen. Dormant shrubs and perennials can be planted if the ground is not frozen. If any plants have been heaved by frost, press the soil down firmly around them.

Tree pruning can be done now, particularly for the removal of dead wood. Be careful not to prune the spring flowering trees. Pin oaks often need attention since many limbs die during the growing season making them very unsightly.

Indoor plants will appreciate periodic feeding, proper watering, and repotting.

Branches of forsythia, pussy willow, and others, cut and placed in water in a warm, light room will provide a foretaste of spring.

Tools should be gone over, repaired, and sharpened. Send lawn mower out for repair and sharpening.

THE GREAT HERBAL OF JOHN PARKINSON

Carla Lange

THE COVER illustrations of the six issues of this year's *Bulletin* will be copies of plant illustrations in John Parkinson's herbal *Theatrum Botanicum, or Theater of Plants*, published in London in 1640. A copy of this herbal is in the rare book collection of the Garden's Library.

John Parkinson was born in 1567, probably in Nottinghamshire, and later moved to London to become apothecary to King James I. He owned a famous garden, Long Acre, where he cultivated many rare plants and spent more and more of his time gardening than practicing as an apothecary. His first book was published in 1629 entitled *Paradisi in Sole Paradisus terrestris, or a choice of Garden of all sorts of Rarest Flowers &c: to which is annexed a Kitchen garden* dedicated to Queen Henrietta. It was not an herbal in the strict sense of the word, but one of the most profound gardening books of that time. In 1640, at the age of 73, he published his principal work, the magnificent herbal *Theatrum Botanicum*, which he dedicated to Charles I. who conferred upon him the title *Botanicus Regius Primarius*. Eleanour Rohde in her book *The old English herbals* refers to Parkinson as "the last of the great English herbalists" and to the

Todd Studio

John Parkinson (1567-1650). This portrait is after an engraving from the collections of the Hunt Botanical Library.

Theatrum Botanicum as "the largest herbal in the English language." It is a folio edition of 1755 pages and contains descriptions of close to 4000 plants. The descriptions in many instances were new and great care was exercised to secure accuracy in indicating localities. This work and the Herbal of Gerard were the two main pillars of botany in England till the time of Ray. Both were inexhaustible resources for all who had any love of plants, or any interest in inquiring into their qualities. Of these two writers, Parkinson was by far the most original and the most prolific. Some papers of Matthias Lobel, the famous French botanist, are said to have fallen into his hands after the death of Lobel. It is certain that he used part of Lobel's descriptions of plants, but since Lobel wrote in Latin, Parkinson had to translate this material. In his *Theatrum Botanicum* he gave very little credit to Lobel except mentioning his help in general, for after all, Lobel was a foreigner and dead for many years and nobody cared.

The ornamental title page of the *Theatrum Botanicum* is an engraving, while the illustrations of the plants described therein were made from woodcuts. On the left side of the middle of the title page, the figure of Adam represents toil, and on the right side, the figure of Solomon represents wisdom. At the four corners of the title page, four continents are represented; Europa driving a chariot with two horses, Asia represented by a female figure riding on a rhinoceros, Africa by a nude female wearing a large hat and riding a zebra, and America by a female figure, also unclad, a bow and arrow in her hands sitting on what appears to be a sheep with unusually long ears. These figures are surrounded by specimens of the plant kingdom of the respective continents.

Parkinson's dedication of his herbal to the king reads:

"To the Kings most excellent Maiestie.
Having by long paines and endeavours, composed this Manlike Worke of Herbes and Plants, Most gracious Soveraigne (as I formerly did a Feminine of Flowers, and presented it to the Queenes most excellent Majesty) I could doe no lesse then submissively lay it at your Majesties feet, to be approved or condemned, and if thought fit and worthy a publique passage, to offer it on the Altar of your Majestyes good. For as your Majesty is *Summus Pater Patriae*, the chiefe of your people under God, that not onely provideth for their soules health, that they mhave the pure Word of God, whereby to live ever,

This copy is of the engraved ornamental title page of the *Theatrum Botanicum*. This engraving, while not in the Garden's edition of the herbal, is in the *Theatrum Botanicum* owned by Hunt Botanical Library.

wherein we justly claime the prerogative above any Nation under Heaven, and most devoutly praise God for the same, and desire religiously to live thereunder: But many wayes also for their bodily estates, by good and wholesome Lawes, that every one may live obediently and peaceably under their owne Vine and Figtree, and by protection, &c. And I doubt not of your Majesties further care of their bodies health, that such Workes as deliver approved remedyes may be divulged, whereby they may both cure and prevent their diseases. Most properly therefore doth this Worke belong to your Majesties Patronage both to further and defend, that malevolent spirits should not dare to cast forth their venome or aspertions, to the prejudice of any well deserving, but that therby under God and good direction, all may live in health, as well as wealth, peace, and godlines, which God grant, and that this boldnesse may be pardoned to.

Your Majestyes
Loyall Subject,
Servant, and Herbarist,
John Parkinson"

It is astonishing how much folk lore Parkinson's herbal contains. Of balm he wrote "it is an hearbe wherein Bees do much delight both to have their Hives rubbed therewith to keepe them together and draw others and form to suck and feed upon." He also said "it hath been observed that bees will hardly thrive well where many Elmes doe grow or at least if they upon their first going abroad after Winter doe light on the bloomings or seed thereof." He also mentioned "Augustus Ceasar was wont to weare bryony with bayes made into a roule or garlande thereby to be secured from lightening."

He gave more recipes regarding the cosmetic virtues of plants than any of the other herbalists. For instance he wrote: "The golden flowers of the blacke Mullein boyled in lye, dyeth the haires of the head yellow, and makes them faire and smooth." Of Southernwood: "The ashes mingled with Sallet-oyle helpeth those that have their haire fallen, or their heads bald, to cause the haires to grow againe either upon the head or beard." Of the commone elder: "The haire of the head or other parts washed therewith, is made black . . . The powder of the seedes, first prepared in vinegar, and then taken in wine for certain dayes together, is a meanes to abate and consume the fat flesh of a corpulent body, and keep it leane . . . The distilled

THEATRUM BOTANICVM:

THE

THEATER OF PLANTS.

OR,

AN HERBALL OF A LARGE EXTENT:

Containing therein a more ample and exact Hiſtory and declaration of the Phyſicall Herbs and Plants that are in other Authours, encreaſed by the acceſſe of many hundreds of new, rare, and ſtrange Plants from all the parts of the world, with ſundry Gummes, and other Phyſicall materials, than hath beene hitherto publiſhed by any before; And a moſt large demonſtration of their Natures and Vertues.

Shewing withall the many errors, differences, and overſights of ſundry Authors that have formerly written of them; and a certaine confidence, or moſt probable conjecture of the true and genuine Herbes and Plants.

Diſtributed into ſundry Claſſes or Tribes, for the more eaſie knowledge of the many Herbes of one nature and property, with the chiefe notes of Dr. *Lobel*, Dr. *Bonham*, and others inſerted therein.

Collected by the many yeares travaile, induſtry, and experience in this ſubject, by *John Parkinſon* Apothecary of *London*, and the Kings Herbariſt.

And Publiſhed by the Kings Majeſtyes eſpeciall priviledge.

LONDON,
Printed by *Tho. Cotes.* 1640.

Todd Studio

This is a photocopy of the informative text title page of Parkinson's *Theatrum Botanicum,* in the Garden's collection of rare books.

Horehound (cover), a copy of a woodcut from Parkinson's herbal, is an herb considered to be a remedy for "those that are pursie, and short winded, for those that have a cough."

water of the flowers, is of much use to cleare the skinne from sunne burning, freckles morphew, or the like." He also mentioned that, "Queen Elizabeth of famous memorie did more desire medowsweet then any other herbe to strewe her chambers withall."

The cover of this issue of the *Bulletin* is an illustration of the horehound out of Parkinson's *Theatrum Botanicum* or *Theater of Plants*. As the virtues of this plant he states among other things that "it is a remedy for those that are pursie, and short winded, for those that have a cough, and for such as by long sicknesse, or thinne distillation of rheume upon the lungs are wasted and fallen into a consumption: it helpeth to expectorate tough flegme from the chest . . . The juyce thereof with wine and honey helpeth to cleare the eye-sight and snuffed up into the nostrils helpeth to purge away the yellow jaundice."

Very little is known about Parkinson's personal life. He died in London in 1650 and was buried in St. Martin's-in-the-Fields. Plumier, the famous French botanist, named the genus *Parkinsonia* in his honour in 1703.

THE RAPE OF PANAMA

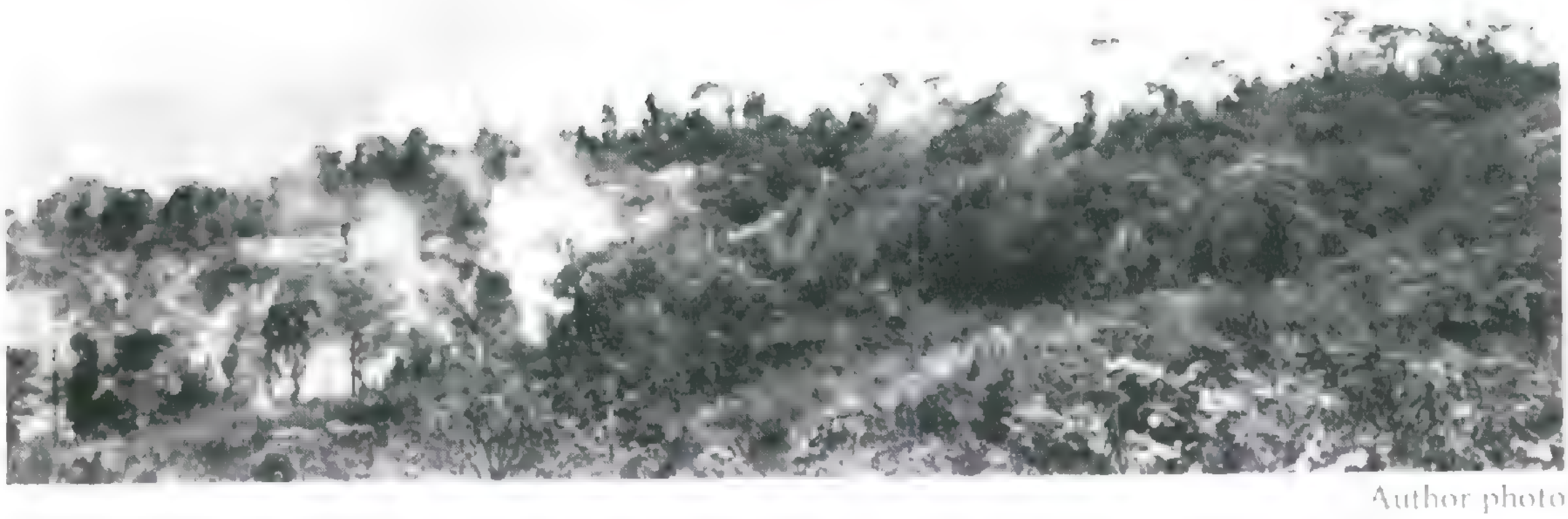
Duncan M. Porter

THE RAPE of Panama began with the visits of Columbus and Balboa, was continued by Drake and Morgan, and persists to this day. The Spaniards, Elizabethans, privateers, and pirates preyed upon men and their gold. The present despoilers prey upon the land.

In January and February, 1967, I sailed along the west coast of Mexico and Central America, from California to the Galápagos Islands and back. Every day and every night we could see smoke and flames from burning forests. Now I've had the opportunity to view the destruction at first hand. The sight is not a pretty one.

From the 22nd of March through the 12th of April of last year, I took part in the latest Missouri Botanical Garden expedition to Panama. The trip was planned to coincide with the last few weeks of the dry season. This is the time of year when the vegetation is at its driest, and also when cutting and burning are at their peak.

For centuries, Panama's agriculture has depended on the slash-and-burn technique, widely used throughout the tropics. Farming and grazing populations throughout the world employ this method, to the detriment of their whole environment. Trees and shrubs are hacked down, allowed to dry, and burned. The resulting ash supplies nutrients for the growth of crops. This release is especially noticeable



Author photo

This huge fire in Cerro Azul, Province of Panamá, is out of control and burning hundreds of acres of forest.

in the tropics, where the living vegetation ties up most nutrients, and therefore soils are poor. After the natural vegetation is burned, crops are planted in the newly fertile soil. In a few years the fertility of the soil is again depleted, and the farmer moves on further into the forest to repeat the cycle.

In preconquest times, when there were far fewer people than today, this system was not especially harmful. In fact, it was the only feasible system for this area, covered with a seemingly inexhaustable blanket of forest. Today, with vastly increased and increasing human populations, the system is unbelievably destructive. It is not simply a case of burning a few acres to plant maize, but of laying waste to whole forests, changing them into blackened scrubland or saw-grass savannas in the space of a few years. Even scrawny cattle find a hard time subsisting on the surviving vegetation.

The slash-and-burn technique may release large quantities of nutrients for plant growth, but it takes from 15 to 50 years for the soil and vegetation to recover before the operation can be repeated

profitably. With expanding populations, more and more areas are being degraded in order to increase the supply of food. The farmers cannot allow time for the land to recover as in the past. Increasing population pressures lead to burning at a faster and faster rate, as well as to repeated burnings of the same areas within the space of only a few years.

Not only do the fires destroy the vegetation cover, but they do untold damage to the underlying soil as well. Leaf litter and humus are destroyed, and the soils become virtually sterile. Tropical soils are notoriously impoverished, notwithstanding the luxuriant forests that may be growing on them. These forests have evolved an essentially closed system, where most of the nutrients are bound up in the protoplasm of the plants, to be released by death and decay, and to be taken up immediately by the plants in place.

As most of the nutrients are in the plants and not the soils, burning exposes them to erosion. As they are released, most of the nutrients are immediately leached downward into the deeper layers of

Author photo

The forest on Santa Rita Ridge, Province of Colón, has been cut prior to burning.

Author photo

At the summit of Cerro Jefe, Province of Panamá, the soil of this road has turned the color and consistency of brick through exposure to the sun and air.

the soil and removed in the drainage water, if not simply removed by sheet erosion, where the top several inches of soil are washed away. The red and yellow tropical soils that support such massive forests also quickly dry out, becoming the color and consistency of brick, when exposed to the intense direct tropical sunlight.

On a collecting trip to Cerro Azul and Cerro Jefe, two of a series of long ridges a few miles east of Panamá City, we came upon a huge fire at Cerro Azul. It was out of control and burning hundreds of acres of forest. Squatters from the Azuero Peninsula, that huge block of land jutting out from Panamá's south-western coast into the Pacific, had set it in order to provide grazing area for their cattle. The eastern provinces of Panamá and Darién are now suffering mightily from the depridations of these squatters, who are forced to move as the self-imposed sterility of their homeland increases.

Cattle are brought in by barge under cover of darkness and released in forests that have been fired to provide grazing areas. As

Author photo

This is the type locality of the orchid *Stelis fimbriata*, Baker, Cerro Jefe, Province of Panamá, as it looks at present. This was tropical rain forest when the orchid was collected.

is the case with slash-and-burn agriculture, immediate results appear encouraging, but saw-grass soon moves into such burned and over-grazed areas. Cattle cannot eat saw-grass—few herbivores besides goats can. These saw-grass savannas are perpetuated by repeated burnings.

It is next to impossible to get rid of squatters. The Panamanian land system is such that not only is it difficult for a poor man to own land, it is also hard to determine which is government land and which private. Therefore, the poor farmer or cattleman takes the easy way out: he simply burns any likely-looking piece of unprotected forest, and settles down on it. When a Panamanian official was asked what the government should do about these squatters in Panamá and Darién, he threw up his hands and answered, only partly in jest, "Shoot them?"

We left the burning Cerro Azul and drove on to Cerro Jefe, where we received a further shock. What had two years before been

lush tropical rain forest was now a few blackened stumps with only sparse living vegetation, nothing remaining over a foot high. An area once traversed by hundreds of species of wild animals was now criss-crossed by cattle trails and beginning to wash away by the acre. R. K. Baker, graduate student at the Garden, pointed to a denuded hillside and said, "That's where I collected a new species of orchid in 1967." This species, *Stelis fimbriata*, has never been collected anywhere else in the world.

There is evidence that wholesale slaughter of the forests is beginning to change the climate of the area. Cutting of forests leads to higher temperatures near the ground; the soil is dried by sun and wind; and springs and water courses dry up. Even where there is no change in the annual rainfall, these adverse effects may occur. Floods, stream silting, and erosion result. Replanting the forests helps stop them; continued burning does not.

An old farmer at El Valle de Antón in Coclé Province told me that there had been an abnormally small rainfall over the past several years. I suggested to him that cutting down and burning the forest might have caused this: that there were now many fewer trees to replenish the water in the atmosphere through transpiration. He brushed my suggestion aside, stating emphatically that the drought was due to the atomic bomb.

Evidence that my suggestion might not be so far-fetched is provided by the Madden Forest Preserve. This stretch of fairly old forest in the Canal Zone is under the protection of the Panama Canal Company. It is transected by the Transisthmian Highway, which runs between Panama City and Colón. On entering the Preserve there is an immediate sensation of coolness and calm. The traveler drives between lofty trees set close together, like Hollywood's idea of the tropics. The interior of Madden Forest must be at least 10° F cooler than the area surrounding it. On every side one sees hundreds of plants rarely seen elsewhere in Panama any more. After several miles he rounds a curve and enters back into the bright sunlight of Panama. The forest ends abruptly at the edge of the Preserve, and the sawgrass and heat begin again.

The plants of the Madden Forest Preserve represent the primeval forest of central Panama. Only in a few enclaves such as these, protected and inaccessable to the squatter, can we get an idea of what the Panamanian forests were probably like before "civilization"

came to the New World. With increasing human population and decreasing vegetation, such areas are becoming fewer and fewer. The loss of these areas means the loss of the plant and animal species they have contained. Few organisms have the capabilities to grow in environments heavily disturbed by man; those that do we call weeds.

Each type of vegetation has species of plants and animals particularly adapted to it. Destroy the vegetation, and these species are destroyed as well. Some organisms must always become extinct through geological and climatic changes, but man is causing the extinction of plants and animals at a far faster rate than natural phenomena have done in the past. The rain forest is a tremendous storehouse of potential resources: for taxonomic and ecological research, and for plant products whose economic value is yet to be discovered. But how can one measure the potential—scientific and economic—of an extinct species?

We must do everything in our power to see that our desire for short-term profits does not deprive future generations of the resources they will need. The situation in Panama is symptomatic of the environmental deterioration that is threatening our entire planet. Not only must large stretches of rain forest be made inviolate, but areas must be set aside for all types of vegetation before it is too late. We need Madden Forest Preserves on a world-wide basis.

Future visitors to Panama should be able to arrive at the end of the dry season and be greeted by clear skies, not by an impenetrable pall of smoke hanging thickly over the land: smoke caused by the smoldering fires burning Panama's irreplaceable forests.

Linnaeus' description of the first pineapple he ever tasted is worth quoting. He said it was like "an apricot saturated with Rhine wine". He, of course, was not dealing with canned pineapple nor with fruit picked green and shipped in. E.A.

OUR SOYBEAN CLIMATE

Why Gardeners Need to Understand it

This is another in the small collection of previously unpublished works of the late Dr. Edgar Anderson.

Edgar Anderson

AS A GRADUATE STUDENT at Harvard's Arnold Arboretum, I began to learn where we must look for trees and shrubs that suit the north-central and northeast United States. Its first director, Charles Sprague Sargent, was an able and many-sided man, a Boston blue-blood, a keen botanist, a forester who had surveyed the country's timber resources for the United States census, a gardener of taste and imagination, a forceful executive, a distinguished editor, and an ingenious amateur climatologist. He was then in his early 80's, still mentally alert and forceful.

In his early years at the Arboretum, he had solved the problem of locating hardy strains of West Coast conifers for Boston parks and gardens. Seeds or plants from the West Coast or from English nurseries were not reliably winter-hardy in the Boston area. He tried strains of the same species from drier sites in the Rockies. My very first morning at the Arnold Arboretum I saw his fine mature specimens of white firs and Douglas firs that were drought-hardy, as well as cold-hardy.

I also saw a whole hilltop with a small grove of young cedars of Lebanon, his most spectacular experiment in acclimatization. When cedars of Lebanon from Lebanon did not prove hardy, he looked for more northern groves of this species. At length he located a German amateur botanist who worked within easy traveling distance of scattered groves in the Antitaurus Mountains of central Turkey. Following Sargent's directions, he collected seed cones from trees on the upper, more-exposed slopes, and all hardy cedars of Lebanon in this country trace back to this shipment.

Our specimens at the Missouri Botanical Garden are still small because it was not practical to try them here until St. Louis solved its soot problem, if not its smog problem. There is one in front of the Experimental Greenhouse and another near the emergency parking lot of the Tower Grove residence.

When I went back from St. Louis to serve on the staff of the Arnold Arboretum in the early 1930's, I studied with Harvard meteorologists at the Blue Hill Observatory to learn in what parts of the world our difficult American climates could be most closely matched. Nowadays several such systems have been worked out but the one most widely used, Koeppen's, is not tuned closely enough to plant reactions to be practically helpful to American parks and gardens.

The one I used is called a climatograph. By plotting average monthly rainfall one way on graph paper and average monthly temperature on the other, all the available facts become 12 dots on the paper for each city whose records you study. Connecting these 12 dots with straight lines from January to February, then from February to March, and so on, around the cycle of the year until you get back to January, gives you a diagram you can compare with the diagram for any other town. Marking each dot with the initial letter keeps the months clear in your mind and ruling a line all the way across the chart for the average yearly temperatures of some one city you know well, serves as an easy placemark when comparing many different charts.

With diagrams like these, it becomes easier and easier to think about the data in terms of what they mean for plants. One locates large areas with very cold, very dry winters like our Great Plains and the Russian Steppes, and contrasts these regions with many places around the Mediterranean with cold, fairly moist winters.

One learns to notice those areas whose cycle of 12 dots spreads all over the chart and to contrast them with England's record. There, winter and summer do not differ greatly in temperature or rainfall. For many choice plants or for visiting Americans the great difficulty is not the extreme cold, it is the lack of sunshine; the very short days, the fog, the sun so low in the sky that a dwarf hedge casts long shadows across the garden. It is a chill, damp world. Only moulds, rots, and chest-disease germs are happy!

As a homesick Midwesterner working over these charts in Boston, I was proud to learn that St. Louis was the only place in the United States which had had reliable daily observations for a century, thanks to Dr. George Engelmann, the botanical godfather of Henry Shaw's child, our botanical garden.

I soon uncovered a set of eastern European climates that were a close match for our difficult midwestern climates—hot in summer, cold in winter, severe droughts at any time of the year, early autumnal frosts every few decades, disastrous late spring freezes often enough to affect what woody plants one can and cannot grow successfully. To succeed in such a climate, plants must be cold-hardy, heat-resistant, drought-hardy, able to withstand winter days arriving overnight during the height of spring bloom and long stretches of summery weather in wintertime.

Working with my graphs, I discovered such a climate in the eastern Balkans, not the beautiful parts which front on the Mediterranean. I also learned then that our climate can't be matched in very many other places. I have kept alert to these possibilities ever since and found a few.

There is central Missouri northeast to Springfield, Illinois, southward to just this side of Cape Girardeau, and westward to Springfield, Missouri. There is the narrow eastern edge of Bulgaria, Serbia, Rumania, and Yugoslavia. There is the fringe of Mongolia near Peking; there are several tiny areas in central Turkey (remember, that's where Professor Sargent found his hardy cedars of Lebanon). There is the southern edge of Manchuria and adjacent China—where the Garden's charming old Oriental spindle trees are native. There is quite an area in central Korea, and there are a few inter-mountain valleys in central Japan. As judged by hardy trees which come from somewhere in Turkistan, there must be places there with this same climate.

The shortness of this list doubles the challenge of our difficult climate; we cannot draw on many of the world's great garden centers in building up our gardens. I believe we would get ahead faster if we had a good common name for this St. Louis climate pattern. In talking informally to gardeners and scientists and the general public I found myself repeatedly referring to our SOYBEAN CLIMATE. It is not a perfect name but I can't find another half as good. Accordingly I now formally christen it the SOYBEAN CLIMATE.

There is a soybean belt in the United States, though so far as I can learn, agricultural experts have never referred to it as a belt (as they do for our corn belt). Figures given out by the United States Department of Agriculture reveal that five states raise the bulk of the soybeans produced in the United States; Iowa, Illinois, Indiana, Missouri, and Arkansas.

Annual soybean yields for all the other states are far lower than they are for any of these five. A map of the United States soybean belt shows that St. Louis is almost exactly in the middle of it. Thus the SOYBEAN CLIMATE is an appropriate term to use hereabouts. Soybeans are grown all around us; south, east, north, and west.

We shall have more beautiful gardens for less work if we learn to hunt out the plants that glory in it. We can use the plants that carry beautiful fall color through a whole month of Indian Summer, we can hunt out the hardy little crocuses that bloom in early spurts of hot weather long before regular crocus are even in bloom.

The rose breeders, the iris breeders, the day lily breeders, the dahlia breeders are meeting the challenge. We do not need to copy the English or the gardens of old Virginia or eastern Massachusetts. We can have as many days of garden beauty per year as they do when we learn how to explore the possibilities of our SOYBEAN CLIMATE.

INDOOR GARDENING

or

How I've Come to Enjoy Winter

Ladislaus Cutak

WINTER IS THE BEST time for evaluating house plants. It is a time for reading, checking, scrutinizing, and planning. There is hardly a home without plants today. From the common heartleaf philodendron that graces a wall vase or a novelty container to a more pretentious bromel or orchid, plants add cheer and relaxation for housewives, businessmen, and growing children. Some plants need very little attention, like the cacti and other succulents, while others demand care and thought for best development. Plants must be treated like pets and will respond to good treatment, like a dog to its master.

In the average apartment or home there are limitations as to space for plants; however one need not be without them. There is always a window, a corner table, a room divider which will hold a single plant or several pots. The main thing to remember is to provide some light during a part of the day, even if it necessitates moving plants from darkened areas periodically. Also there are various light units easily available and fluorescent light tubes can be arranged almost anywhere in the room, basement, or attic. For the more affluent, lighted carts can be purchased and often fit in as a piece of furniture. More modern homes usually have ample windows or even glass walls permitting generous amounts of natural lighting. These spacious homes often have terrazzo floors with planting beds at floor level or planter boxes elevated on masonry.

The average plant lover needs only a few fundamental rules to successfully grow plants and, once these are mastered, endless pleasure will be the net result. One need not have a green thumb; only a desire and love for plants. Familiarity will breed knowledge as one cultivates and cares for his plants, and reading specific gardening books can help immensely. Fraternizing with friends who share this

A few of the more popular house plants are: (Left top to bottom) Dieffenbachia, Orchid, Coleus. (Right top to bottom) Monstera, Billbergia, Gloxinia.

hobby permits exchange of helpful ideas and avoidance of mistakes.

If you are interested in growing house plants and keeping them in good condition, evaluate the time you can give to them. Do not attempt to grow plants that are very demanding unless you can give them the right environment, right conditions, right care. A good many plants are quite tolerant of house conditions and often manage to thrive even under adverse conditions.

First of all, let's consider the right environment. Will it be a window that has a wide sill, can glass shelves be installed, and is it it drafty? A window logically is the ideal location for growing plants, but even a window may have its drawbacks if it is sunless and not insulated. Plants in poor light, particularly the flowering kinds, never flourish and usually become etiolated (spindly), miserly in leaf growth, and colorless. There are homes in crowded communities where windows never receive any direct sunlight.

Plants do need a sunny location, or at least, a well-lighted one to carry on photosynthesis, the process that stimulates growth. A windowsill is sometimes hardly big enough to grow any number of plants but if glass shelving can be installed, the whole window can be utilized. This is great for cacti and succulents, bromels, African violets and other plants that stay small. Large individual plants like scheffleras, dracaenas, palms, rubber plants, and self-heading philodendrons can be included near the window, around the fireplace or mantel, in the hallway, or a nook. These varieties of plants can thrive in reduced light and are excellent foliage plants.

Plants grown in a planter box often do best when double potted. The method is to place a potted plant in a larger container and then pack wet peat moss, sphagnum, or sand in the void. Keeping this material moist keeps the soil in the pot from drying out, thus there is less need to water. Pots exposed to the air dry out much faster. Another advantage to this method is that potted plants can be shifted or replaced at will so that the planter box will present a good appearance at all times.

There are many kinds of plants suited for the home and often the puzzled indoor gardener will have a hard time deciding which to grow. Let's consider succulents as a start. In the long run they are easiest to manage and grow well under household conditions. Can you think of another group that has such diversity of form and shape, such coloration as the cacti? When we use the term succulents

Kalanchoe blossfeldiana "Vivid" is a plant with handsome foliage and breathtaking flowers.

Author photo

this applies to plants that are fleshier than the normal ones and which can live without water for indefinite periods. Cacti are excellent examples. A succulent plant is usually shallow rooted and therefore is able to absorb and hoard moisture within its fleshy body, stem and leaves and then utilize it during dry periods. The grotesque and bizarre shapes of cacti are a means of survival adapted to inhospitable regions where they grow. Their bodies are usually globular, hemispheric to columnar, and have ribs or tubercles. Sometimes the stems are partially or even wholly covered by an armament of spines, prickly hairs, or thick wool-like hairs. This, and the fact that the epidermis is parchmentlike slows down transpiration.

The cactus family contains hundreds of mini-cacti and lots more maxi-cacti to be used as accent plants, depending on your wants. Mammillarias, rebutias, lobivias, echinopsis and most of the echinocactus segregates can be grown to perfection. Individual

specimens usually need a 3 to 4 inch pot and they need not be transplanted for years. The very tall species of the cereus group should not be avoided because they can be kept in the juvenile stage. They include the popular hairy and woolly types that endear themselves to the plant lover. If spineless types appeal more than the prickly kinds, there are lots of these, too. They can be grown more in shady places and should be watered more often.

Other succulents include spurges, stonecrops, stapeliads, figmarigolds, and a host of miscellaneous ones. Many of these resemble the true cacti like the euphorbias, while others are either stemless mimicry plants like pleiospilos, lithops, faucarias, or shrubby as mesembryanthemums, kalanchoes, aeoniums. The rosette-forming echeverias are particularly good and plants belonging to the genus *Crassula* contain some real gems. Many succulents also have a vining or trailing habit and make wonderful hanging basket material like the ceropegias, sedums, stapelias and kleinias.

Do not overlook sansevierias which have many qualities to recommend them as decorative material. For the most part they are bold plants and seem to fit into modernistic atmospheres more than any other plants. The elegantly long, exquisitely marbled, or striped plants are as rugged as can be and thrive in well-lit or shady sections of the house. They will withstand lots of abuse on the wet or dry side and seldom are attacked by any insects. *Sansevieria hahnii* is unlike any other sansevieria, its leaves arranged in birdnest fashion and is fit subject for a novelty container or dish garden. The stiff upright leaves of many sansevierias are often used in flower arrangements.

Bromeliads have stirred up quite a bit of interest in this country in the past 25 years. These members of the pineapple family possess year-round good looks. The leaves often form a whorl or rosette or are arranged into a vase or urn in which water is held. This makes a living vase which can support cut flowers like roses, daisies, etc. Bromel leaves often are beautifully mottled, marbled, striped, or spotted in various becoming shades and when they come with flowers are a stunning object. Bromeliads are either epihytic or terrestrial, preferring trunks and branches of subtropic trees or growing in all kinds of ground, often in drier regions. When the indoor gardener learns what kinds he has, he can supply the proper care.

Aroids for the most part are excellent house plants. Numbered

in that group are the philodendrons, monsteras, dieffenbachias, aglaonemas, anthuriums and spathiphyllums. All of these can tolerate extremes of watering and can also endure fluctuating temperatures between hot and cold. The philodendrons are remarkably good as accent plants and thrive in dimmer parts of the house. The vining types can be grown on totem poles but the self-heading kinds are perhaps more desirable for decorative purposes since they tend to spread rather than grow tall. Dieffenbachias or dumb canes have been house favorites for a long time. When they get too tall, the tops can be cut off and rooted. Propagations can also be started from sections of the canes. The most popular is *Dieffenbachia amoena* from Colombia. Anthuriums are of two types: the "tail flower" group has handsome foliage but often inconspicuous blooms, while the "flamingo flower" group has plain foliage and spectacularly colored inflorescences.

Palms are sometimes referred to as the aristocrats of the plant world. There are at least a thousand species—not all suited for the average home except when in the juvenile stage. They fit better in business offices, hotel lobbies and large reception centers. The slender but most graceful and compact chamaedoreas are choicest products for the home. They grow in small containers, have no desire for strong light, and stay fairly dwarf, up to about four feet high. Palms need plenty of water in either warm or air-conditioned homes.

In a class with the palms are the upright dracaenas like *D. fragrans* and *D. deremensis*, both of which contain varieties with variegated foliage that need no special care except that they are kept moist. Fit companions are several polyscias, particularly *P. balfouriana* and *P. filicifolia*. A most delightful relative is *Dizygotheca elegantissima* with long narrow jagged leaflets of darkest color. The fiddleleaf fig is popular as well as the plain green form and the variegated rubber plant. The last two belong to the *Ficus* group which has a great number of durable species and, where height and spread is desired, should not be overlooked.

Whether you prefer only the small plants or the more decorative tall-growing kinds, you are sure to find satisfaction and cheer for the small amount of care you bestow on your house plants. These are but a few to consider. Visit a greenhouse or read a book on house plants and then make your choice.

SOIL AND ITS IMPROVEMENT

Robert Dingwall

SOIL IS ACTUALLY composed of two layers; an upper layer called topsoil, and a lower layer known as subsoil. The topsoil is usually darker in color because of its higher content of decaying vegetation and animal matter, or humus. In this layer, life in such forms as bacteria, fungi, insects and other small organisms is more abundant. This topsoil layer may vary from a depth of 1-2 inches to as much as a foot or more.

Deep topsoils hold more moisture and nutrients than shallow ones. Plants will grow in shallow topsoils, but just as when grown in pots, they need more fertilizing and watering than they would if grown in a deeper topsoil. The lower layer of soil, or subsoil, is lighter in color, harder to dig when dry and often stickier when wet.

Good soil should contain minerals or inorganic particles, air which fills voids between the particles that are not occupied by water, and teeming hordes of living insects, worms, minute animals such as protozoa, as well as fungi, bacteria, and other primitive life. All these constitute the population which gives the soil its animate or living nature.

Soil texture is usually graded according to the size and type of mineral particles; e.g. coarse sand, fine sand, silt, or clay. The soil

in and around the St. Louis area can be classed as a silt soil, which is in between sand and clay. The particles are smaller than sand grains and pack closer together, with smaller air spaces between them, which slows down the movement of air and water in the soil. This type thus drains more slowly and remains moist over longer periods. It is difficult to improve, since neither liming, frost, or cultivation will granulate or reduce the stickiness of it. Large dressings of bulky organic materials need to be mixed in to make working this type of soil easier.

The soil should have what is called good tilth. This is a term used in referring to the fitness of the soil for the growth of plants. The traditional method for building and maintaining tilth is to work in bulky organic manures that rot into humus, which is a valuable soil conditioner. To do appreciable good, a large amount of organic matter is required. A good thick layer of 2-4 inches of manure, compost, peat moss, or similar material should be applied all over the soil, and thoroughly mixed with it.

Gardeners have been working on soil improvement for centuries as this 16th century woodcut from an herbal by Adamus Lonicerus shows.

Soils rarely have enough organic matter, and this is why it should be added not just once, but every year. The organic matter is being continually broken down by the living organisms in the soil, which require food and energy. This organic matter also improves the physical condition of the soil. It holds moisture in the soil, and when used as a mulch on top, helps to control the soil temperature, to reduce losses by evaporation and to keep down weeds. It is a chief source of nitrogen in the soil, and when well worked in to a good depth, encourages deep rooting of plants so that they are able to withstand the long hot periods in summer.

It is not sufficient to have good tilth just at the surface of the soil, with the balance lumpy below. What is really required but often hard to achieve in practice, is a system of large pores, running down to a depth of 15-18 inches at least for annuals and perennials, through which fresh air can circulate and where moisture is held to meet the needs of the roots.

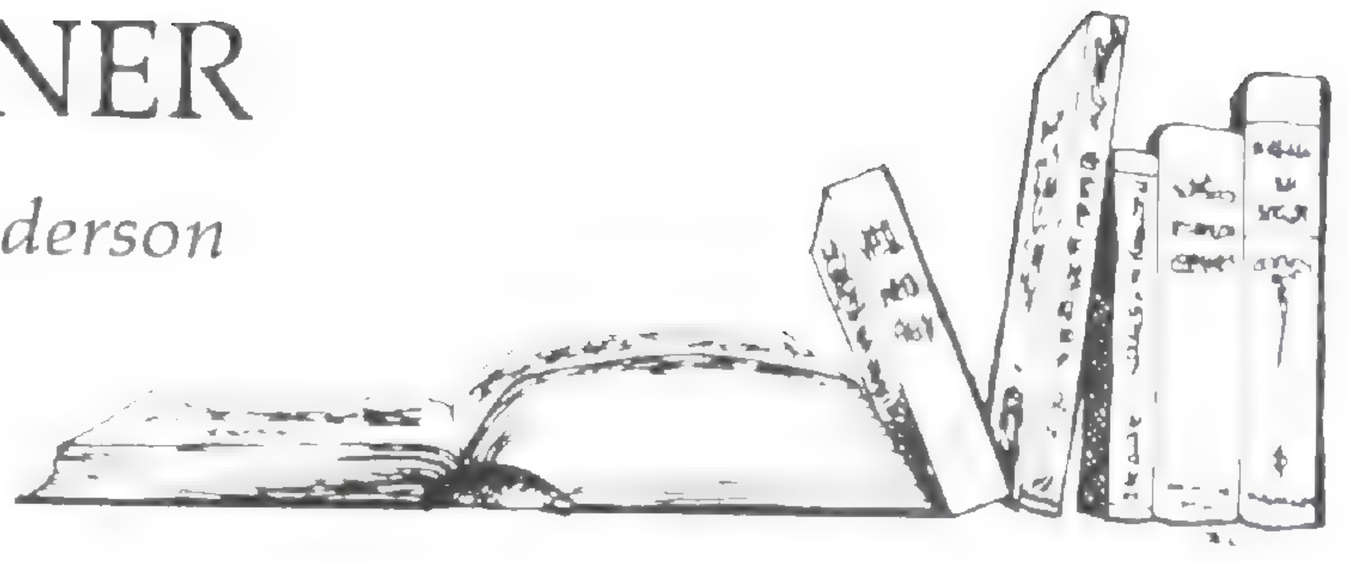
To maintain good tilth and keep it once it has been produced is important. If drainage is not good then artificial drains may need to be installed. Too much water in the soil will smother the plant by cutting the air off and will also drain out the soil micro-organisms which are so essential to plant growth. These organisms feed on the organic matter, breaking the nutrients down into a form that the plants can absorb.

In the established garden, humus in the form of decayed plant matter, such as leaves, etc. that were composted, should be added to the garden in either the spring or fall, or even better, at both times, and lightly worked in around the plants. This method not only maintains good tilth, but produces healthy plants which resist diseases and harmful insects.

Plant hardiness depends not so much on the type, or variety of plant, but upon the soil in which it is grown; as a healthy plant will survive hot and cold periods much better than a poorly grown, weak plant of the same type.

BOOK CORNER

A Review by Edgar Anderson



HOW TO HAVE A GREEN THUMB WITHOUT AN ACHING BACK

by Ruth Stout (Cornerstone Library)

THIS 160 PAGE BOOK gives such excellent advice pertinent to gardening in St. Louis that it caught the eye of Bruce MacBryde, one of our graduate students, who gave his copy to me on an extended loan.

Ruth Stout lives and gardens in suburban Connecticut. Now a sprightly old lady, she was in vigorous middle age when she left New York City and reverted to the country living of her childhood. She had grown up in Kansas in a loving but hard-pressed Quaker family with eight brothers and sisters. In spite of the difficulties of gardening during Kansas droughts, she developed a deep-seated enthusiasm for vegetable gardening. Both horticultural and literary interests ran in her family. One brother grew up to be Rex Stout; creator of Nero Wolf, the detective who raised orchids in a roof-top greenhouse. Ruth Stout's husband took up novel writing after his retirement. This background makes her booklet interesting as well as informative. She frequently drives a key point home with a quotable phase: "Farmers have learned that it is less wearing to shrug their shoulders than to beat their breasts," or "It is the leaf of the plant that needs the sun, not the fruit."

The main point in Ruth Stout's book is the importance of heavy mulching, *very* heavy mulching. The chapter that describes her techniques is headed: "My Garden is My Compost Pile."

The following is a condensation of the chief points in that chapter, as far as possible using only her own words. The final item is from chapter II:

"My way is unscientific but it has produced fine vegetables for eleven years. I simply spread the mulch where I want it to compost. It rots and becomes rich dirt, keeping down weeds, keeping the earth soft, holding moisture, eliminating ploughing, spading, hoeing, and cultivating. I use lime to keep the soil from getting acid. I put some cottonseed meal on strawberries, lettuce, corn, and beets to supply nitrogen. People who feel they must, can have their soil analyzed to find if anything is lacking.

"If you start gardening on an area covered with grass, skip the ploughing; put on top soil and then a covering of leaves and hay. You can have a garden next spring if you import the top soil. Even at my age I do everything myself but never work after two o'clock in the afternoon except for real emergencies. If you get tired squatting and kneeling and bending you can sit. Use a kneeling stool with raised curved bars which you use to let yourself down or up, also a place for small tools. At first I thought it was a little 'la-de-da' but now I use it constantly and would hate to be without it."

Those who have gardened successfully in greater St. Louis have learned the importance of heavy mulching such as Ruth Stout recommends. A very few, Mr. Edgar Denison of Kirkwood for example, have carried it to seemingly fantastic limits and demonstrated what can be done by composting leaves. Now that leaves cannot legally be burned in St. Louis County, it is to be hoped that more and more county gardeners will work out convenient and tasteful ways of mulching the unwanted leaves, as well as mowed grass, and "spoiled hay" (the common trade name for hay that has rotted so much that cattle and horses will not eat it). Combined with leaves or top soil, it makes an excellent mulch and is not unsightly.

Ruth Stout's manual is noteworthy as a non-fanatical approach to organic gardening. The latter frequently degenerates into ranting, too much of it without critical evidence to back up its claims. An able and scientifically-trained gardener from New Zealand told me that among his friends, the organic farming movement was referred to as "muck and mysticism!"

On the other hand, I can confirm Ruth Stout's temperate discussion of the claim of many organic gardeners that many gardening chemicals are dangerous. On page 71 you will find her detailed description of the lengths to which manufacturers of chemical sprays and dusts will go to influence radio stations and the editors of horticultural magazines.

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Illustration is from a woodcut of the
mountain rose *(Rosa alpina)* in
John Parkinson's *Theatrum Botanicum*
published in London, 1640.

ANNUAL REPORT-1969

A Significant Decade

Mark W. Paddock

IN RELATION to the total number of years the Missouri Botanical Garden has existed, the decade of the 60's comprised only 9% of its history. However, in terms of truly significant events, the impact of that decade will be felt for many future generations.

The world famous Climatron, under construction as we went into the decade, was completed and opened to the public in October, 1960. This unique structure quickly became an international trademark of the Garden and millions of visitors have enjoyed its tropical environments. The Climatron was the first major change in the concept of conservatory design since the development of the Crystal Palace in London in 1851. There is little doubt that the Climatron and its vital influence permitted the Garden to enter the 60's with optimism.

In 1963, Dr. Frits Went, Director since 1958 and creator of the Climatron, resigned. Dr. David M. Gates assumed the position of Director in September 1965. The immediate challenge to Dr. Gates and his administration was to place the institution on a fiscally firm foundation. The initial need was to operate the Garden within the budget. We are pleased to report that this difficult task has been accomplished each year since—in the face of much new development and inflationary pressures.

Dr. Edgar Anderson, perhaps the most original thinker ever to be on the staff of the Garden, retired in 1967 and died suddenly in his home at the Garden in June 1969. Dr. Anderson was director of the Garden in the mid-fifties.

Mr. George Pring came to the Garden near the turn of the century and after over 50 years at the institution, much of it as Superintendent, retired in 1963. For several decades George Pring was known as Mr. "Shaw's Garden" to hundreds of thousands of St. Louisans.

One of the precedent-breaking decisions relating to the Garden was made in 1966 when an admission fee was initiated. For over 100 years all visitors entering the Missouri Botanical Garden paid no fee. It was only because of the pressure of continued inflation and fiscal needs that this decision was reluctantly made by the Board of Trustees.

Perhaps the most momentous decision in the history of the institution for over half a century came in 1968 when the Board of Trustees decided to hold the first Capital Fund Drive in 110 years since Mr. Shaw established his Garden. As the decade ended, we were assured of the success of this $3,000,000 drive. Just as the Climatron enabled the Garden to enter the 60's optimistically, this $3,000,000 will enable the institution to enter the 70's with a feeling of optimism perhaps unequalled for 50 years.

An institution must keep pace with the demands of the future. We have seen the problems of the environment reach crisis proportions in the last decade. The Missouri Botanical Garden with its

Claude Johnston

Institutions like the Missouri Botanical Garden are indebted to an outstanding group of civic minded citizens for their continued operation and success. The Board of Trustees of the Garden, shown here with staff members at their regular October meeting, have worked especially hard in 1969, perhaps harder than any Board in the history of the institution. The fact that the Capital Fund Drive has been successful can be attributed primarily to the dedication of this Board to the Garden.

abilities and knowledge in the area of natural history, systematics, ecology, and education, has assumed an increasingly large role in environmental research and education. Much of our basic research can be applied directly and indirectly to solving our environmental problems and our staff members have been asked to serve on local and national committees, boards, and task forces dealing with the environmental crisis. Our education department has added many courses prepared to teach the layman about ecological problems and their solutions.

It is increasingly evident that new programs for visitors must be developed if the Garden is to continue as a major source of education and information in the community. Botanical garden educational programs have traditionally been built on a broad base of classical botany and horticulture. A new program must be superimposed on this base, tying the botanical gardens to the community at large. Botanical gardens could take an important lead in pointing out and solving problems of urban deterioration. By helping people understand how they are a part of nature, it may be possible to more effectively involve them in programs of restoration and preservation.

Education Department

Kenneth O. Peck

THE EDUCATION DEPARTMENT ended the sixties with a record performance which can be attributed to the expansion of the department in both personnel and the scope of previously established programs.

Mark Paddock instituted the Garden's new volunteer guide corps. The guide program has been piloted by Mrs. H. Parker Smith and Mrs. Edward Cissel working in cooperation with the Education Department. In their first complete year of service, twenty trained guides told the Garden's story to 8400 visiting children and adults. Since their initial training, the guides have been trained to give five different tours which are listed in the 1970 Course Brochure. This group has cheerfully performed in an outstanding fashion. During the summer a group of the guides gave tours on several mornings a week to people as they came through the gate. This part of the program was handled by Mrs. James Warnhoff.

Art Filmore

Every summer many children enjoy the opportunities to study and learn more about natural history through the Garden's Pitzman Summer Nature Study Program.

Overlapping from 1968 was the work with the inner city youngsters from Jefferson School. This was a twenty-session series of lessons in plant science which was climaxed by a bus trip to the Arboretum in mid-April to see natural landscapes at their best.

Continuation of education for guides has been given throughout the year and plans have been made for training new guides in January, 1970.

In May, the Education Department offered a science workshop for school teachers, given in cooperation with the St. Louis Board of Education and Harris Teacher's College. There were sixty-six teachers who attended four early evening meetings for one college credit. Such a program involves cooperation with other departments like the Herbarium, Library, Maintenance, and Horticulture.

Programs for children prospered. The Pitzman Summer Nature Program encountered some very difficult weather patterns. Nearly 4000 visits were made by youngsters interested in studying the wonders of nature. The Audubon Society's bird study program introduced the youngsters to a wide variety of people and animals, including reptiles brought from the St. Louis Zoo by Charles Hoessle,

an officer from the Missouri Conservation Commission, and privately owned animals and birds, brought in by individuals. Bird study programs were given by Mrs. Cecil Criger and Mrs. Robert Higgins. A new facet of the Pitzman Program was the use of an inflatable life boat to facilitate the study of the Garden's lake. This program, a twelve year success story, is only possible because of the continued generosity of the Pitzman Charitable Trust.

More than 15,000 children participated in the Saturday program, tours given by staff, plant science lessons, and the Pitzman Program mentioned above. More than one-third of these young people came in class groups from nearly 120 schools for plant science lectures. Lessons on seeds and major plant groups are two favorite subjects followed by plant structure and the two hour workshop in tree identification. The "Pond Walk" was a favorite of classes which were preparing to go to nature camps last fall.

Attendance of adult courses has fared much better in 1969 than in recent years. A total of 1118 visits in fifty-six class meetings has made this a busy year. New or special courses held in 1969 were:

"Landscaping the Home for Living", given by Harris Armstrong, Architect.

"Japanese Flower Arranging", given by Mrs. Walter E. Morris.

"Botany for People", given by Kenneth Peck.

In the ebb and flow of human interests, it is difficult to predict response to courses and classes which are competing with many other events offered by a large city. We are proud that nearly 26,000 people chose to participate in our education program.

Herbarium

Susan Verhoek-Williams

IN THE ANNUAL REPORT for 1960 the Curator of the Herbarium cited the lack of adequate space as a reason for incorporating into the Herbarium fewer specimens than in the previous year. In the Report for 1962 he stated that the facilities were "crowded to

Claude Johnston

Dr. John Dwyer and Dr. Thomas Croat study plants they have collected for the Flora of Panama research project.

the point of sheer desperation; it has not a single full time employee charged with its administration and maintenance . . . The herbarium's situation has now reached a point where a realistic program for its solution must be undertaken . . ."

At the end of a decade, in 1969, there is proof that the declining trend has been reversed. There are now two employees charged with supervising the collection. The space problem which plagued the early part of the decade has been somewhat alleviated. In the spring of the year, the massive move of specimens into the Herbarium Temporary Annex and into the remodelled basement of the Administration Building allowed the creation of office and work space for staff, the reorganization of the Cryptogamic Herbarium into a more efficient facility, and the easing of crowded conditions in half of the cases which remained in the Herbarium. At this time no additional

space was provided for the material which was moved into the annex and basement.

In the coming year we will test a solution to herbarium space problems with a section of a new storage facility called the Compacter. Instead of being stored in rows of cases with doors and aisles between, the specimens in the Compacter are stored in rows of doorless cases which fit together tightly in a block when not in use. To gain access to one of the cases the user turns a wheel at the end of the proper row and the block slides apart to create an aisle.

This small section of space-saving storage will be only a temporary solution. As the year 1969 progressed, it became evident that the increased number of specimens handled in the past decade requires ever-expanding facilities. The number of incoming shipments of plant specimens for 1969 is more than double that of eight to ten years ago. Some of the increase is due to loans requested by staff at this institution or sent here for identification; at ninety-three, totaling 4435 sheets, this is the highest in the decade and 30% more than in 1968. The loans themselves are an indication of the large amount of work being carried on by staff and students in the Herbarium.

The ninety-eight loans requested from the Herbarium during the past year is also more than twice the 1960 figure and, with 11,253 actual specimens sent, is far greater than the 1606 sheets sent in 1960. The larger number of specimens loaned is due in part to the larger size of the collections which have added 250,000 specimens since 1960. This past year we have mounted 24,967 specimens. Of these, 24,352 have been accessioned for our Herbarium and the rest have been sent to Barro Colorado Island in the Canal Zone as a check herbarium there.

Some of the newly mounted specimens are material received in exchange. The 7573 sheets of exchanged plants is double that from the beginning of the decade. This year, exchanges sent out-numbered 3455.

The balance of the new specimens received were outright gifts, gifts in return for the determination of specimens, and collections made by Garden staff. During the past year we have received as gifts: D. M. Eggers' study collection of *Valerianella*, Illinois plants collected by R. A. Evers, and Russian plants collected by Oscar Soule. As gifts for determination we are currently identifying Panamanian collections by H. H. Bartlett and T. Lasser, E. L. Tyson, J. H. Kirkbride, Jr., and J. A. Duke; R. G. Koch's Costa Rican material and in-

sect-related plants of Mexico collected by C. D. Johnson. The majority of mass identifications were done by Dr. John Dwyer, Dr. Derek Burch, Dr. Richard Maxwell, Royce Oliver, and Susan Verhoek-Williams.

Some of the collections made by the Herbarium staff this year came from Brazil through the efforts of Dan Austin, from general collecting by the staff throughout the United States and Canada, and from the March-April expedition to Panama led by Drs. Lewis and Porter. In addition, Dr. Lewis and Dr. Tom Croat each made several trips to Panama, and Dr. Croat collected in Colombia. Dr. Dwyer made three trips to Panama and on the third also collected in British Honduras, Guatemala, and Costa Rica.

The Missouri Botanical Garden's ties with Panama have long been recognized by the botanic community. Now the relationship has become a more intimate one with the organization of the Missouri Botanical Garden Canal Zone Herbarium at Summit Gardens. During 1969 we have been setting aside duplicate Panamanian material for future mounting and shipping to the new branch.

In addition to progress in Panama, two events during the past year have ensured the Herbarium's growth in another direction. The first is the recognition of the Missouri Botanical Garden as the official repository for African material in North America. This move is supported by the major herbaria in the United States and has received endorsement by herbaria in Africa. The designation of such a center for African study encourages, with the cooperation of the other herbaria, the development of a substantial, broadly-based collection of African plants. The reputation of the Herbarium as the African center on this continent will bring many botanists here for study.

The second event was the presentation to the Garden of a gift to be used for the purchase of plants from Africa, the Middle East, and Australia. Should specimens not be available for purchase, the income from the endowment is to be used to finance a graduate fellowship. It is gifts such as this that make the future of the Herbarium look very bright.

At the end of this ten year period it is pertinent to list some of the major collections that have been incorporated into the Herbarium during that time. Some of the collections are centered around specific groups of plants. These are mosses collected by Rev. Robert Brinker, roses from the E. W. Erlanson collection, *Juniperus* studied

by van Haverbeke, Robert Kral's study collections of *Cyperaceae*, and specimens from which the *Flora of the Queen Charlotte Islands* was written.

Library

Eugenia Maddox

THIS HAS BEEN a year of great physical change for the Library. A grant of $17,000 from the National Science Foundation made possible the purchase of steel shelving for the new storage annex, the ground floor of the main library, and the folio collection. It also provided funds for office furniture and equipment. A major gift of $59,000, to be given over a three year period, was received late in 1969 from the Allen P. and Josephine B. Green Foundation. This large grant will be used to restore, bind, and rebind thousands of volumes now in desperate need of attention. In addition, funds will be used to employ a cataloguer to process both current acquisitions and a large accumulation of books and periodicals.

These grants will have a lasting impact upon the Library for generations to come. We can now anticipate bringing the library into first rate condition.

Vast improvements were made in staff offices. The combined office-folio room was completely renovated during the summer months. Formerly, this room was a cluttered and unattractive place with ugly brick walls, a worn concrete floor, high ceilings, a combination of fluorescent and incandescent lights, and indiscriminately strung electrical wires. The valuable folio volumes housed here were standing or, in some instances, lying on crudely made rough wooden shelves. Now, the ceiling is lower and is of acoustical tile, lights are flush with the ceiling, there are adequate electrical outlets, walls are panelled, and the floor carpeted. Approximately one third of the folio volumes formerly shelved here have been placed on folio shelves in the locked cage, but because of lack of space in the cage, the rest of the collection must remain in the office.

An area of approximately 900 square feet was assigned to the Library in the storage annex. Thousands of books and journals form-

Claude Johnston

In early 1969 a metal annex building was erected just north of the Growing Ranges to house the overflow from the Library and Herbarium.

erly stored in sealed boxes in various inaccessible parts of the administration building have been moved to the annex. In addition to material from dead storage, certain classes of infrequently used publications were transferred to this building.

Additional space for the Herbarium and the Library's book repairers was provided by the removal of books from the ground floor of the administration building. As a result of thoughtful planning by the three book repairers, this is an attractive, well-lighted, and conveniently arranged room.

Staff and students continued to make heavy use of the Library. Circulation figures do not reflect this because it is impossible to keep such a record, the reason for this being that taxonomists consult countless references, but in many instances need only an illustration, a paragraph, or a page or two of text at most. This results in their using many books and journals without borrowing them for home or office use.

As in the past, the Library had many visitors, some who merely wished to see it, but many more who wished to make use of its resources. Not only botanists, but other specialists found answers to their questions in the Library's remarkably fine collection of books, journals, microforms, and manuscripts.

The selection of books and journals for the Library is a major activity of the professional staff. A continuing effort is made to secure current as well as older books and serial publications needed in the library. This year there was a marked increase in periodical subscriptions. Microfiche copies of eleven important herbaria were noteworthy additions to library holdings during 1969.

The backlog of books to be catalogued is slowly being processed, approximately 400 volumes having been processed during 1969. Also added to the collection were some 650 bound periodicals. A selected list of books catalogued has been issued monthly or bimonthly throughout the year.

It would be impossible to list in this report the many gifts received. However, we wish to thank all of those who have so generously contributed books, journals, or funds for the purchase of library materials. We are especially grateful to the National Council of State Garden Clubs for the funds they have donated for the restoration of our rare books.

A volunteer worker who has made a valuable contribution to the Library is Mr. Julius Boehmer, who worked one day a week

sorting, listing, and packing approximately 10,000 journals received from the St. Louis Academy of Science. Mrs. Linda Thies, another volunteer, also assisted briefly with this work.

In addition to their regular activities, professional staff members represented the Library at various local meetings of librarians, and the Librarian attended a meeting of botanico-horticultural librarians held in Boston, November 13.

Mrs. Carla Lange selected from the collection of rare old herbals the wood-block prints to be copied for the covers of the 1969 issues of the *Missouri Botanical Garden Bulletin*. She also wrote for the *Bulletin* a series of articles about the works from which these illustrations were taken.

An article by Eugenia Maddox, entitled "Missouri Botanical Garden's Library is One of State's Priceless Resources", appeared in the August issue of *Show Me Libraries*, the publication of the staff of the Missouri State Library. Excerpts from this article were printed in the October issue of *The Slate*, published by the Greater St. Louis Chapter of Special Libraries Association.

Kendra Lovette, book binder, had a two-month training period in New York with Mrs. Laura Young, one of the nation's authorities on book restoration. While receiving training, Kendra was able to restore seven of the Library's rare volumes.

The arranging and filing of the map collection is the Library's next project. Concurrently, we have plans for simplifying the arrangement of journals, so that their use by non-library staff members will be facilitated. We are also devoting a great deal of thought and careful planning to the proposed library-herbarium building.

Research

SYSTEMATICS

Walter H. Lewis

THE SCIENTIFIC strength of the Missouri Botanical Garden for the past 110 years has lain in its systematic collections and research, and in the training offered to botanists. There have been

periods when the herbarium and library were relatively inactive, but in general they have always been at the center of the activity which has made the Garden internationally respected.

With man's encroachment on and destruction of the natural environment, there has never been a greater need for a full understanding of the evolutionary processes. The pace of destruction has accelerated over the past generation, but at the same time support for research in systematics has declined. Training in systematics, such as that given at the Garden, is fundamental to this understanding, and because the need is so great we dare not risk standing still or interrupting this work."

This charge quoted from the founding document of Institute for Systematic and Evolutionary Botany illustrates the intent of the Garden's scientists to move forward vigorously in their study of systematic and evolutionary botany. The charter members include Thomas B. Croat, Marshall R. Crosby, Hugh C. Cutler, John D. Dwyer, David M. Gates, Richard C. Keating, Walter H. Lewis (as chairman), Eugenia Maddox, and Duncan M. Porter.

Claude Johnston

Terry Luikart photographs pollen grains with the Electron Scanning Microscope at Washington University for comparative studies in plant classification.

First consideration of the Institute is the revitalized program of graduate training through Washington University. Here the newly constituted Department of Biology, which includes all instruction in botany, provides the broad-based curriculum so essential to excellence for further systematists. Add our association with St. Louis University and Southern Illinois University at Edwardsville and we have a consortium of four institutions contributing to a curriculum for graduate education in the greater St. Louis area. As a result we are now able to provide one of the best training programs on the continent.

The existence of the Institute will also stimulate efforts for collecting in tropical regions. The need to find sponsors for scientific exploration in areas acutely affected by population pressures and land misuses is ever increasing.

Activity in systematics during 1969 centered around Panama. A major event was an agreement between the Panama Canal Company and the Garden to establish a systematic facility at Summit Gardens in the Canal Zone. Air conditioning is being installed in what will be a herbarium and library, area and facilities are being readied for pressing, drying, and mounting specimens and for the planting of notable species in the Gardens.

Dr. Thomas B. Croat spent January through March in Panama collecting specimens and other data for his ecotaxonomic manual of Barro Colorado Island. Over 5000 collections have been made and most of his time is needed to determine this material. Nearly 30% of the species are new to the island. Tom attended the Second International Symposium for Amazonian Biota in Leticia, Colombia, and along with most staff and students attended the Eleventh International Botanical Congress in Seattle during August and September.

Dr. Marshall R. Crosby, Curator of Cryptogams, continued the curating of moss specimens with the expert help of Mrs. Olga Herrera-MacBryde. After collecting in Panama during the spring, Marshall extended his exploration to several West Indian islands including Jamaica, Puerto Rico, Martinique, and Guadeloupe. Material collected will do much to strengthen the Garden's holdings in these critical tropical areas.

Dr. John D. Dwyer continued his identification of Central American plants following field trips to Panama, British Honduras, Guatemala, and Costa Rica. One of John's students at St. Louis University, Jerry Castillon, accompanied him and other Garden

botanists to Panama after being awarded the trip through the Camelot project of the Arts and Education Council.

In December, Dr. Dwyer received a contract through the Organization of American States and the Instituto Centroamericano de Investigacion y Technologica Industrial of Guatemala City, permitting him and two students to collect, and process for natural extracts, plants growing along the relatively unexplored Carribean side of Guatemala, Honduras, Nicaragua, Costa Rica, and Panama.

Dr. Richard H. Maxwell is now Assistant Curator of the Herbarium and, in addition, is studying a member of the legume family on a post-doctoral fellowship.

Dr. Viktor Muehlenbach continued his study of adventive plants along the railroads of St. Louis. At least six species new to Missouri were found during 1969.

Dr. Joan W. Nowicke completed extensive studies of the *Boraginaceae* and *Labiatae* for the Flora of Panama including the description of several new species. Joan is actively working on the *Apocynaceae* and plans to publish a treatment for this difficult group in 1970.

Dr. Duncan M. Porter participated in the spring expedition to Panama and with Dr. John H. Thomas of Stanford University led a post-Botanical Congress field trip from Seattle to San Francisco. He is working currently on the *Burseraceae* for the Flora of Panama.

As chairman of the Garden's symposium for 1969, Duncan was busy hosting a successful gathering of over 200 scientists in October. The topic was Tropical Island Biogeography with Dr. Marston Bates of the University of Michigan as moderator and papers presented by Dr. Hampton L. Carson of Washington University, Dr. Paul L. Colinvaux of Ohio State University, Dr. Alan Graham of Kent State University, Dr. Terrell H. Hamilton of the University of Texas, and by Drs. Croat and Crosby of the Garden staff.

Students receiving graduate degrees during the year were: Dr. Thomas Elias (Ph.D.) who prepared a monograph of the genus *Hamelia (Rubiaceae)* under the direction of Dr. Dwyer; Dr. Raymond Altevogt (Ph.D.) who worked on the biosystematics and origin of *Medicago* (alfalfa) with Dr. Edgar Anderson until his death in June; Mr. Joseph Kirkbride (M.S.) who completed a revision of Panamanian species of *Rondeletia (Rubiaceae)*; and Mr. Dan Austin, Mr. Jon Hawker, and Mr. William Grant each awarded A.M. degrees (without thesis) from Washington University.

Students currently working for graduate degrees in systematics under the direction of Dr. Dwyer include: Yow-Yuh Chen who is working on a study of the pollen grains of the Panamanian genera of the *Rubiaceae;* George Romano who is studying the plant anatomy of eight tropical members of the family *Acanthaceae;* and David Spellman who is working on a check list of the flowering plants of British Honduras. Dr. Lewis is directing the following students in their studies toward graduate degrees: Richard K. Baker who is studying plant distribution; William G. D'Arcy who is studying *Solanaceae* in Panama; Bruce MacBryde who is working on a revision of *Galphimia (Malpighiaceae);* Kenneth R. Robertson who is doing a revision of *Jacquemontia (Convolvulaceae);* and John Semple who is working on the distribution of pubescent genes in *Conocarpus erecta (Combretaceae).*

The systematic staff looks to the new decade with optimism and encouragement. Continued and accelerated progress toward a better understanding of plants and their diversity is our goal.

USEFUL PLANTS

Hugh C. Cutler

RESEARCH AT THE GARDEN on the evolution of useful plants is concentrated on corn, squash, pumpkins, gourds, and their wild and weedy relatives because abundant archeological and modern specimens of these plants can be obtained. The history of corn and squash is complex, but large collections and experiments with living plants make it possible to trace their developmental patterns. Collections studied at the Garden last year came from nearly every American country from Chile to Canada and represented the years from about 6000 B.C. to the latest harvest.

Biologists, anthropologists, and geographers from more than 100 institutions have sent materials to the Garden in recent years for identification and interpretation. Reports on these collections, participation in seminars and lectures, and cooperation at field schools and archeological excavations encourages the continued flow of plant remains needed to enlarge our knowledge of how useful plants evolved and spread. Collections of wild and weed plants around archeological sites and modern fields and of cultivated plants grown nearby are useful for comparisons with the kinds of plants excavated.

Dr. Hugh Cutler and Mr. Leonard Blake lectured, participated in seminars, and gave reports at the Universities of Illinois, Kentucky, and Missouri, and at meetings of regional and national research groups. Dr. Cutler spent most of October visiting eleven institutions in New Mexico, Arizona, and California. At the United States Department of Agriculture's Horticultural Field Station near San Diego he studied the experimental plantings of wild and cultivated squashes from tropical America. Tropical squashes can be grown outdoors in the latitude of southern California but are killed by frost in St. Louis before they ripen. Crosses of the many wild and cultivated squashes help to determine the patterns of relationships and may yeild new combinations of desirable characters such as disease-, pest-, and drought-resistance, good quality, high yield, and marketable shapes. Grants from the National Science Foundation and from some of the cooperating institutions financed these expeditions and meetings.

Last summer four midwestern institutions had crews excavating parts of the Cahokia Indian mound area in the East St. Louis area. From studies of these new and earlier collections a review of the agriculture of this important prehistoric cultural center was prepared. Reports on some of these studies have appeared in various technical journals.

ECOLOGY

David M. Gates

THE PROGRAM in plant and animal ecology at the Garden grew considerably during the year as the number of postdoctoral fellows and research associates increased substantially. With the grant from the Ford Foundation in its second year we have become known as the place to be for the study of biophysical ecology. We assume a strong quantitative, analytical, and mathematical approach to our study of ecology. Since ecology is the study of the interactions between plants and animals and the environment we recognize the need to more thoroughly understand the characteristics of the physical environment.

An organism is coupled to its environment through the flow of energy. If sufficient energy does not come to a plant or animal from the environment then it will get too cold, not function properly, and perish. If too much energy flows to the organism from the environment it will get too hot, not function well, and perish. For each and

Claude Johnston

David M. Gates, Director of the Missouri Botanical Garden since September, 1965, is a pioneer in the field of biophysical ecology. He is seen here in the new gazebo near the Lehmann Rose Garden.

every organism there is a fairly specific amount of energy which it must receive in order to function properly. We have learned how this energy flow occurs and precisely what it means to the plant or animal. But an organism also must exchange gases with its environment. A plant, in order to photosynthesize, must take in carbon dioxide and give out oxygen and water vapor through its stomates, the small pores in the leaf surface. An animal must take in oxygen and breathe out carbon dioxide and water vapor. The process of gas exchange for a plant leaf is a problem in the physics of gas diffusion. Within the leaf itself the carbon dioxide must be assimilated by means of photosynthesis at the same rate at which it diffuses in through the stomates.

The rate of photosynthesis depends upon the temperature of the leaf, which in turn is a result of the energy budget, and depends upon the light intensity which in turn is a component of the energy budget. The rate of photosynthesis is also a function of the carbon dioxide concentration in the atmosphere. The process of photosynthesis is extremely complicated, but is the heart beat of the pump by which a plant takes in carbon dioxide and builds new plant tissue.

To understand how a plant lives within its environment we must understand not only photosynthesis itself but also the gas and energy exchange between it and the environment. These events which go on

constantly in the daily life of a plant are fundamental to plant productivity. All life on earth depends upon the primary productivity of plants. The oxygen we breathe comes from plants. All animals—all birds, mammals, reptiles, insects, bacteria, etc.—depend upon plants to start the whole process.

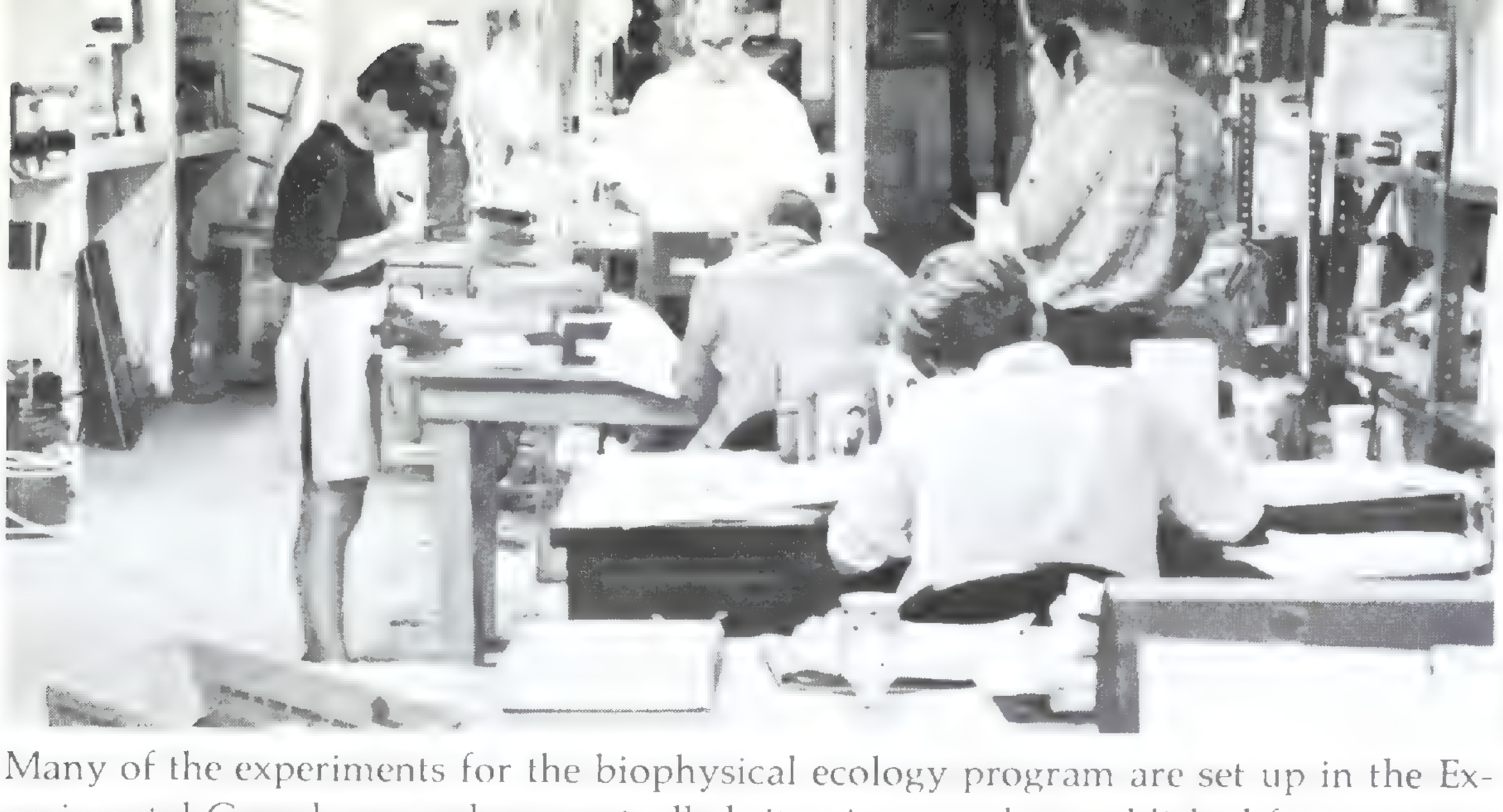
Each plant species has very special characteristics and has evolved to live within a particular environment. We are trying to understand adaptation of plants to their environment because this is basic to our understanding of productivity, of plant distribution, and of evolution. This is why the biophysical-ecology group is concentrating its efforts on this one problem.

In order to remain oriented to reality we not only do laboratory experiments and mathematical calculations, but we go into the field in order to see how plants are functioning in natural and in disturbed environments. During late July and August the biophysical ecology group went to Mt. Hood, Oregon where a week was spent at the 6,000 foot level of this 11,600 foot mountain. Mt. Hood is an isolated volcanic cone covered with glaciers on its upper slopes, creased by glacial melt waters rushing down radial canyons, and covered with meadows and forests up to the icy edges of the glaciers.

The diverse and interesting ecology of the mountain includes timberline, an abundance of magnificent alpine flowers, the revegetation of lava flows which occurred as recently as the turn of the century, the occurrence of parch blight among the spruce and fir trees, and the devastating effect of massive rock slides on the forest. The members of the biophysical-ecology group were guests of the Snowshoe Club at their Cloud Cap Lodge. Bob Lee, Vice President for Public Relations of the Georgia Pacific Corporation, and Jack Baldwin, both veteran mountaineers, took the entire party onto the Eliot Glacier for a look into the forbidding ice blue crevices. They and Cranson Fosburg led the group on an all day hike to Elk Cove to witness the full beauty of a glacier fed mountain meadow in July.

Following the week on Mt. Hood the group spent a few days on the Olympic Peninsula and in the rain forest. From there they attended the International Botanical Congress held in Seattle during late August.

From April to December the biophysical-ecology group was fortunate in having in residence at the Garden Dr. Conrad S. Yocum, Professor of Plant Physiology, University of Michigan, who worked with the group on the problems of energy and gas exchange in plants.


Claude Johnston

Many of the experiments for the biophysical ecology program are set up in the Experimental Greenhouse, where controlled situations can be established for comparison with field problems.

In January 1969, Dr. Paul W. Lommen, a physicist and Assistant Professor at the University of Wyoming, joined the group as Assistant Project Director for biophysical ecology. Dr. Lommen's keen knowledge of physics and mathematics is of great help in analytical research.

Dr. Oscar Soule, an ecologist from the University of Arizona, is a Fellow in the Center for the Biology of Natural Systems. He is working with Dr. Gates on problems of energy budgets of animals with special attention to the influence of animal size and its effect on energy exchange and climatic adaptation.

Dr. Hyrum B. Johnson, Ford Foundation Postdoctoral Fellow, from Columbia University and The New York Botanical Garden, is working on energy and gas exchange of plants as related to ecological adaptation.

Dr. Shmuel Moreshet, Ford Foundation Postdoctoral Fellow, from The Volcanic Institute of Agricultural Research, Bet-Dagan, Israel, is working on water loss from plants and the fundamental problem of trying to get the greatest plant productivity for the least water use, an issue of vital import to those people living in arid regions of the globe.

Dr. Christa Schwintzer, Ph.D. University of Michigan, Research Associate on the Atomic Energy Commission grant, is interested in matters of energy exchange for plants and the role it may play in sleep movements of plant leaves and leaf adaptation to environment.

Dr. Jesse H. Bennett, Ph.D. University of Utah, is a Fellow with the Center for the Biology of Natural Systems working on energy and gas exchange of plant leaves as it pertains to air pollutants which attack the metabolism of plants and destroy productivity.

Ronald G. Alderfer was awarded a Ph.D. degree by Washington University in July 1969. His thesis subject was *Studies of Energy Exchange between Plant canopies and the environment*. He has been with the biophysical-ecology group from its formation at the Missouri Botanical Garden in 1965. Dr. Alderfer is now an Assistant Professor of Biology at The University of Chicago.

Laverne Papian, applied mathematician, continues to be helpful in every way. A great deal of the research by the biophysical ecology group involved the use of large digital computers. Mrs. Papian in collaboration with Dr. Gates prepared an *Atlas of Energy Budgets of Plant Leaves* for publication, a task which required many computations and the plotting of numerous graphs by computer. Mrs. Papian is working on computer programs of solar and sky radiation as a function of various atmospheric conditions.

Sylvia Morhardt, Ford Foundation Fellow, is a candidate for a Ph.D. degree at Washington University. Mrs. Morhardt is studying the interactions of *Citellus beldingi* with its environment with particular attention to its energy exchange. Her study area is a meadow in the Sierra Nevada Mountains near Bishop, California. By means of small radio telemeters which are implanted in the animal she is able to record their heart rate, which is correlated with their metabolism, permitting them free movement in their normal habitat.

Elwynn Taylor, Research Associate in the Center for the Biology of Natural Systems, is a Ph.D. candidate at Washington University and is studying the ecological adaptation of plant leaves through an analysis of energy exchange. Mr. Taylor has taken a special interest in the plants of Panama.

Much of the Research which is achieved in the biophysical-ecology group is only possible because of the great help rendered by two research technicians, Jerry Pingel and Bill Davit, who take care of the plants in the greenhouse, look after the equipment and instrumentation, and help to make some of the measurements.

RESEARCH GRANTS

BASIC RESEARCH activities at the Garden continued to expand during 1969. Research projects require financial support and the Garden is fortunate to be the recipient of a number of grants and contracts from various federal agencies and national foundations, primarily due to the fine scientific reputation of its research

staff. Financial support for research projects at the Garden include funds for research associates, graduate student fellowships, and research assistants. Following is a list of the research grants in effect in 1969:

Title	Agency	Amount	Period
"Energy Exchange within Ecosystems"	Atomic Energy Commission	$ 24,859	1 year
"Biophysical Theoretical Ecology"	Ford Foundation	$420,000	5 years
"Revision of the New World Group of Chamaesyce"	NSF	$ 17,500	4 years
"Systematics Symposium (1968) The Practical Value of Systematics	NSF	$ 1,650	1 year
"Identification & Interpretation of Plant Materials from Archaelogical Sites"	NSF	$ 11,340	1 year
"Maintenance & Curatorial Support of MBG Herbarium & Library	NSF	$ 49,000	1 year
"Flora of Panama (4th Cont.)"	NSF	$ 73,500	2 years
"Publication of Annals of the MBG"	NSF	$ 29,300	3 years
"Operating Support of MBG Systematics Facility"	NSF	$ 10,680	1 year
"Temperature and Light within Ecosystems"	Office of Naval Research	$ 12,309	1 year

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Horticulture

Robert Dingwall

THIS HAS BEEN a year of progress and change in Horticulture. During the summer a very complete inventory was made including plot plans of all the trees and shrubs growing on the grounds. This work will be continually updated and corrections made when needed so that the Garden will continue to have an accurate record of this material.

The lake area was heavily mulched last spring and has now reached a state of decay where an excellent humus layer is being formed; ideal for planting native wildflowers and shrubs. There is wide interest in growing and preserving the native flora, and this area will also give added interest as a teaching area. A light mulch will be added annually to insure good soil requirements, to hold down weeds, and create a fine looking low maintenance area.

Landscaping of the Tower Grove Parking Lot was completed. Use of this lot north of the main entrance has increased as people have become aware of its convenience.

The Climatron continues to flourish, making it necessary to constantly prune and thin out specimens. The old coarse mulch has been removed and is being replaced by humus in the form of screened leaf mold. This gives a much neater appearance and has prevented the planting areas being used as a place to throw refuse by the visitors. Dead leaf material is also removed daily and not allowed to accumulate. More orchids have been added to the area at the top of the waterfall. Future plans call for adding more variety in the plantings and more labels to identify the material.

The rose gardens under Alfred Saxdal's care have continued in excellent condition; in fact, they have been in better condition this year than ever before. The Missouri Botanical Garden may well claim to have the best rose garden in the nation and is fortunate in having a rosarian of Al Saxdal's quality.

A collection of "Old Roses" that are now hard to obtain was started in the spring. These have been set out into a nursery area back of the parking lot. The idea is to secure a number of these roses and grow them over a period of time to find out which ones will do well in this area. Later, suitable roses will be placed in a permanent

planting where they can be viewed by the public. Many of these have historical value and a use in future research.

After careful consideration and evaluation of the orchids and general plant collection, it was found that a large quantity of plant material was not being used and had little value for future use. This surplus stock was offered to the Friends of the Garden, who held a very successful Surplus Plant Sale in late October. The profits were given over to the Garden to start on renovation of the old Citrus House. Present plans call for opening of this section to the public on a limited basis by early February. Special groups of plants will be grown here, displays showing different aspects in the life of a growing plant, and other exhibits will be set up and changed periodically for an interpretative education program. In this program the Garden will be able to demonstrate and show what is involved in growing plants and the effect they have on our environment as well as the esthetic and economic value.

The Garden is fortunate in receiving financial support from several of the garden club groups—notably the St. Louis Herb Society. With this generous help the Garden has been able to get equipment and supplies much needed in both the greenhouses and on the grounds. The Herb Society also very ably plants and maintains the Herb Garden behind Tower Grove House.

The Hemerocallis Society, realizing that the Garden not only needs plants but funds to maintain them, very generously gave a cash donation to help towards the upkeep of their special planting of daylilies. Through annual giving such as this the Garden is assured of support in maintaining special plantings.

Generous help has been given by various other individuals and groups on a voluntary basis in planting and care of certain areas in the Garden.

When George Pring moved from St. Louis, the Garden lost a great telephone Answer Man. To fill this vacancy, volunteers from the Men's Garden Club came forth and have freely given of their time and experience. They come in Monday through Friday from 9:00 a.m. until 12:00 noon to answer all calls coming to the Garden for help requested by the general public in regard to problems dealing with their own needs in all phases of horticulture. A program was set up in the fall with the cooperation of the Missouri Extension Department so the Answer Men could attend a two-hour meeting once a month to further their knowledge in seasonal topics.

Mark Paddock

Robert Dingwall, who joined the Garden staff as Chief Horticulturist this past summer, is working hard to see that the Garden's horticultural program keeps pace with our times and serves the public well.

The Garden has entered into a new program with the St. Louis Board of Education, with funds available from the Federal Government. This is called Project STAY. In this program twenty students from Soldan High School will come to the Garden for three hours a day, Monday through Friday, to receive basic training in gardening. The lake area has been selected as the pilot area where the students will start and will cover various aspects dealing with pruning and planting. The program will start in late January and run until the end of the school term in June. Program coordinators will help the students find summer work in horticulture and then they hope to continue the work-study program in the fall.

The Horticulture Department feels that more emphasis should be placed on finding out the effect that pollution has on our plants and just what will grow in this area. This means the growing of more evergreen materials such as different conifers that are presently lacking in the Garden. More variety is needed in shrub material. Along this same line, many specimens in the Garden are too old to renovate by pruning, and need to be replaced. A nursery is needed where this material can be grown until ready to go into permanent plantings.

The Garden must be the leader in growing and testing new materials so people may observe them first hand and determine what will do best in this area.

Arboretum

Andrew Johnson

THE ARBORETUM played host to the National Audubon Convention field trip in April, when over four hundred people roamed the woods and fields in search of birds and enjoyed Missouri's spring landscape. Prior to the walks, Garden staff discussed the Arboretum and its natural history. Dr. Joseph Shomon, Director of the Audubon Nature Center Planning Division, and his assistant, Mr. Ray Kordish, made a special tour of the Arboretum during the convention. Dr. Shomon stated that the Arboretum has a great potential as a Nature Center and if the Arboretum could develop along such lines, it would become a center of national prominence.

The southern portion of the Arboretum, south of the Meramec River, has been the scene of increased activity this year. We received assistance from the students at Washington University for the installation of indoor plumbing, painting the farm house, and generally renovating the facility. Over two thousand dollars was provided by E.E.D.I.N., a student fee-supported activity at the University. During the fall semester, eleven students have been living at the farm as part of a new program in experimental education. The students run the farm, cook for themselves, and take up to five courses taught by faculty members who each spend one day per week at the

The Arboretum in Gray Summit increasingly provides opportunities for nature lovers to enjoy the many varieties of landscape to be found in Missouri. Hikers, bird watchers, and flower lovers enjoy all seasons at this preserve.

Andrew Johnson

farm. The major aims of this program are: to attempt to break down traditional barriers and thus encourage dialogue; to use the rural setting for ecological investigations and discussion of environmental problems; and to draw upon actual experiences of the group to reinforce principles and concepts traditionally taught in the formal classroom.

The road system at the Arboretum was improved considerably. Over one thousand tons of crushed rock was spread on the roads. Mr. Steinberg and his staff have kept up with mowing and maintenance in a fine manner, and the Arboretum continues to look exceptionally good. Since rainfall in 1969 was abundant, the grounds are lush, and should provide a fine spring show.

Maintenance

Andrew Johnson

THE MAINTENANCE STAFF under the direction of Jim Hampton completed one of its most successful years. New staff members plus special funds allowed for some of the most comprehensive renovation projects tackled in recent years. The Floral Display House roof was completely replaced with fiberglass and power ventilation that allows for increased cooling in the summer as well as better air circulation in the winter. The Floral Display House projects were completed by our own staff after several contractors rejected the project as too difficult.

Automatic ventilation was installed in the Linnaean House, the Lean-to, and three of the Display Growing Houses. This greatly increases our efficiency and provides better temperature control.

Another project that was just a dream in July is now reality. The American Desert House has a new roof of fiberglass and a power ventilation system similar to the one in the Floral Display House. The fiberglass extends down on the south side of the building about fifteen feet further, thus allowing more light for better growing conditions. The old roof dated back more than fifty years and was beyond repair. Other changes in the Desert House are rather extensive, and we hope to open most of it in the early spring.

Claude Johnston

Replacing the outdated roof of the Desert House with a modern Fiberglass one was one of the Maintenance Department's major projects in 1969.

Renovation of portions of the Administration Building also added to our appearance and effectiveness. Dr. Lewis' office and the Library office were completely renovated. The basement was remodeled and new lights added.

A new Publications Office was developed in the basement of the Tower Grove House and the kitchen area redecorated.

Moving was another big project for Maintenance. The Library and Herbarium Annex was completed in the area just north of the growing ranges thus requiring a major move from the Administration Building to the Annex. Publications was moved into Tower Grove House; Dr. Cutler was moved into Dr. Anderson's office, and the Education Department moved into Dr. Cutler's old office.

This was a major renovation year, and the staff can point with pride to the efforts and efficiency that has been displayed by our maintenance and grounds crew.

Friends of the Garden

Lorine Compton

IN 1969, THE FRIENDS of the Garden continued their support of the Missouri Botanical Garden. Their support has traditionally been primarily financial and comes from membership fees and proceeds from the Garden Gate Shop. But recently there has been increasing involvement of the Friends in the greater role of the Garden —preserving and understanding the green world—by working directly with the Education Department on the Guide Program, and by helping the Horticulture Department with the development of the new Growing Center.

The Friends "Super Sale of Surplus Plants," held October 25, realized approximately $4,400; this money went directly to the Horticulture Department for the Growing Center. The plant sale is to become an annual event, with proceeds going to the continued development of the Growing Center. Mrs. Tom K. Smith coordinated all aspects of the sale; the Friends who purchased the plants are those who are making the Growing Center possible.

Two special events, for Friends only, were held during 1969. A standing room only crowd of over 200 people attended a lawn

Claude Johnston

Members of the Friends of the Garden look forward to the Preview Parties which open the Garden's Flower Shows. Corky the Clown, also known as Cliff St. James, was on hand to wish the children a Merry Christmas at the Preview Party for the Poinsettia Show.

clinic presented by Nelson Russell on September 6. Mr. Russell not only educated people on lawn care, but entertained them with his delightful wit. He discussed the major points of lawn care, including the use of such equipment as the power rake, vertical grass cutter, and the aerator. In December, "Holiday Ideas for Friends of the Garden" attracted a large group that was inspired by Mrs. J. Glennon Schreiber of the St. Louis Herb Society demonstrating how to make bay, laurel, and herb wreaths; and Lloyd Kallial demonstrating "Surprise Packaging"—original ideas for wrapping gifts. Mrs. Adolph Conrad was in charge of these special events.

June 11 the outgoing Women's Executive Board of the Friends of the Garden gave a Thank You Coffee for the many volunteers who help at the Garden throughout the year. The guests of honor were welcomed and thanked by Dr. Gates and Mrs. Guy W. Oliver. Mrs. Frank Hendrickson was chairman of the event, and she, too, deserves a "thank you" for being one of our dedicated volunteers.

The membership committee, under the direction of Mrs. G. Carroll Stribling, has worked diligently throughout the year compiling a list of prospective members. A new membership brochure has been designed which tells the story of the Garden and the importance and benefits of being a Friend. The first group was mailed during November, and the mailings will continue into spring. The initial response has been gratifying.

In 1969 the Garden Gate Shop again contributed substantially to the income of the Garden. Mrs. Holland F. Chalfant, Jr. and Mrs. Alexander M. Cornwell, Jr. assumed the co-chairmanship in June, following a very successful year under the direction of co-chairman Mrs. Tom K. Smith, Jr. and Mrs. Thomas R. Collins, Jr. The shop is managed by Mrs. Edwin F. Stuessie and staffed by trained volunteers who are recruited by Mrs. Leighton Morrill and Mrs. Frank Hendrickson. Visitors appreciate the Shop for its fine imaginative merchandise and as a good source for publications about gardening and natural history. In addition to being open every day of the week for business, the shop set up special booths for the Chrysanthemum Show under the co-chairmanship of Mrs. Edwin Russell and Mrs. John Toring Brown.

Eighteen Friends, accompanied by Lad Cutak of the Garden staff, participated in the Garden Tour of South America in January 1969. Each member of the tour contributed $250 to the Garden.

"Friends Day" during Henry Shaw Week was a huge success. Luncheon in the Floral Display House, featuring recipes from the Henry Shaw Cookbook, was a sellout; Lad Cutak lectured to a full house in the Museum Building; the Flower Wagon ran at capacity all day; special "Behind the Scenes" tours were conducted by the Guides; and the day ended with a traditional European Mai Day Fest with a Mai Bowle. The Maypole dance was performed outdoors by young students from The Wilson School.

Preview parties continue to be popular and attract large crowds. We are particularly grateful to Stix, Baer and Fuller and Famous-Barr for donating refreshments and music for the Chrysanthemum and Orchid Preview Parties, respectively. The Spring Flower Show was unique this year—Watercolors by James Godwin Scott and sculpture by Simon Ybarra were displayed among the spring flowers. The Poinsettia Show Preview Party was again a children's party, featuring Corky the Clown, the Repertores singing carols, and Santa; each child received paper white narcissus bulbs with instructions on growing them.

Mrs. Guy W. Oliver served as President of the Women's Executive Board until May, when Mrs. Walter G. Stern was elected the new President. In January, 1969, Mrs. Robert Compton became Executive Secretary of the Friends of the Garden.

Tower Grove House

Mark Paddock

ASIDE FROM BEING one of the world's great botanical gardens, noted for visual display of plants, basic research and education, the Missouri Botanical Garden is fortunate to have many structures of special historical significance within its walls.

The Historical Committee, consisting of: Mrs. Jerome F. Kircher, Chairman, George Brooks, Mrs. James D. Streett, Mrs. William G. Bowman, Mrs. Neal S. Wood, and Mrs. John S. Lehmann, is responsible for historical features at the Garden.

Their primary interest has been Tower Grove House, the 121 year old mansion of Henry Shaw. Visitors to the Garden have the

opportunity to visit a magnificently maintained and furnished home, in addition to seeing the other Garden attractions.

Through loyal volunteer and staff hostesses, visitors are given personally guided tours through the house seven days a week. In 1969 over 25,000 people enjoyed the tradition of old fashioned hospitality that Mr. Shaw endowed to the Garden.

Claude Johnston

The backyard garden of Tower Grove House, originally Henry Shaw's country home, is a blaze of color throughout the growing season; as many different varieties of flowers are planted in rotation, so that there is always something at the peak of bloom.

Public Relations

Ladislaus Cutak

DURING THE YEAR the public relations department was busy staging various displays in stores, bank lobbies, hotels, and schools to advertise various functions and services performed by

the Garden. Many of these exhibits were done in conjunction with the Capital Fund Drive to publicize the Garden's role in the science world and the community.

The display cases in the Museum Building received fresh exhibits in time for the Symposium and will remain several months to be enjoyed by the societies that hold their meetings there. All of these displays try to depict the tremendous amount of service which the Garden provides to the community.

Radio and television play an important role in publicizing the Garden. Our staff members frequently appear in feature programs and interviews. Many spot announcements relating to activities like flower shows, children's nature programs, and other events are aired. The interviews centered on many subjects such as plants, their care, current flower displays, gardening problems, and community services.

Illustrated lectures were given to garden clubs, civic groups, and church organizations both locally and out of town, and even in foreign countries. During the South American Garden Tour sponsored by the Friends of the Garden, Lad Cutak gave slide talks on the Garden in Buenos Aires, Bariloche, and Lima.

Judging at flower shows is another community service often performed by the Garden staff. During the year Lad Cutak judged the Scott Air Force Base flower show, the Spring Show of the St. Louis Horticultural Society, the Fall Show of the Midwest Regional Council, the Cactus Show of the Henry Shaw Cactus Society, a flower show of the Webster Groves Men's Garden Club, and the front yard gardens of the Cabanne Plaza Association.

After nine years of the Climatron's existence there still are many inquiries about the structure and plantings as well as several inspections by architects and garden center designers from many lands.

Metropolitan newspapers have been consistently generous in carrying various photos, features, and press releases that keep the Garden before the public. *The New York Times Magazine* (October 5, 1969) carried an excellent comprehensive article, "Saving the World the Ecologist's Way", by Robert Stock. This article has had tremendous impact in telling of Dr. Gates' ecological research centered at the Garden.

Magazines also have given us wide coverage. *Bride's* magazine carried a pictorial feature, "Young Individualists", in the March issue and photographed a young couple at our mum show and in the

orchid range. *Better Homes and Gardens* published a special 146-page "Travel Ideas 1969" and included the Garden with its Climatron. *Urania*, German scientific magazine for July, featured the Garden. *Grit*, family weekly, ran a story on the Climatron. Various house organs, such as *Laclede News* and *Mercantile News*, printed feature stories about the Garden.

Most significant were two outstanding books, *Great Botanical Gardens of the World* (Macmillan) and *Great Gardens of America* (Country Beautiful in association with G. P. Putnam's Sons). These expensive volumes are lavishly illustrated and each devotes several pages on the Garden. We were also considered for *Museum Adventures* (Coward-McCann) and supplied photographs. In many other instances, photos and information were supplied to various publishers and authors whose books have been published or are in the process of being printed.

The Garden is often the focal point for many visitors to St. Louis and among them are quite a few famous people in the entertainment field. During the year we had visits from Eleanor Steber, Metropolitan Opera soprano; Hildegarde, supper club song stylist; Vic Perry, television and night club entertainer and a good flower arranger; Cynthia Pepper ("My Little Margie" series); David Hedison (Captain Crane in "Voyage to the Bottom of the Sea" series); Earl Wrightson, musical comedy and television singer; and Lesley Gore, recording star, to name a few.

Publications

BULLETIN

Barbara Lawton

THE MISSOURI BOTANICAL GARDEN BULLETIN, our primary publication is bi-monthly and averages 32 pages per issue.

The *Bulletin's* aim has always been to present: (a) information about the Garden; its people and its activities; (b) horticultural information of general interest to gardeners in this region; and (c) botanical information for the interested layman.

For our covers we have continued to use copies of woodcuts and engravings from the Library's rare and valuable herbals. 1969 featured woodcuts from the *Latin Herbarius* printed by Peter Schöffer of the Gutenberg Press in Mainz, Germany in 1484.

In 1969, the *Bulletin* in its articles, recognized the greatly expanded research and educational programs at the Garden. Articles such as "Animal Research at the Garden" by Warren Porter describe aspects of the biophysics ecology program. Articles such as "Botanists and Electrons" by Walter Lewis, "Along the Railroad Tracks" by Viktor Muehlenbach, and "Barro Colorado Island" by Tom Croat describe aspects of the research being done in systematics.

A newsletter, *The Garden Today*, was begun in March, 1969. This newsletter comes out the 15th of each month except for July and August and is distributed in the St. Louis area.

An in-Garden staff newsletter was begun in the fall of 1969 to answer the need for better communication among our over 100 staff members. This mimeographed newsletter has run three issues and is proving increasingly popular.

The Publications Department, jointly with the St. Louis Herb Society, produced a small book, *How to Grow Herbs in the Midwest*, in early 1969 which has been selling well.

An index to the *Bulletins* from 1960 through 1967 was compiled and published, and indexing is being kept up to date in current volumes.

A new give-away guide folder was designed and printed by the Publications Department in late 1968.

A series of reprints have been made from the *Bulletin* for educational and public relations use. These include "Botanists and Electrons" by Walter Lewis, "Trees of the City" by Kenneth Peck and Sandra Thornton, and "Honeydew," also by Peck and Thornton.

Publications Department has helped maintain and encourage contact and use of Garden material by NET Channel 9, newspapers, radio, and T.V.

Publications has grown to include Manager of Publications, Barbara Lawton; Editorial Assistant, Cynthia Tjaden; Circulation, Clarence Cherry; and a high school work-study student, Joni Bailey.

We have been very fortunate to have the assistance of graphics designer, Peter Geist, as well as the photographs and help of Gene and Erlene Nachsted of Shaw Camera Shop and freelance photographer Jack Zehrt.

ANNALS

Marshall Crosby

SEVERAL MAJOR CHANGES involving the Annals, scientific periodical of the Missouri Botanical Garden, occured during 1969. In May Dr. Walter H. Lewis gave up editorship of the Annals after a five year tenure. Dr. Derek Burch became editor temporarily and began preparing the first two numbers for 1969. In September Dr. Marshall R. Crosby became permanent editor and saw these numbers through the presses. Miss Sheri G. Davis is now Assistant to the Editor.

The Editorial Committee of the Annals presently consists of, in addition to the editor and his assistant, Dr. Duncan M. Porter, Dr. John D. Dwyer, and Dr. Joan W. Nowicke. Dr. Porter also functions as Editor of the *Flora of Panama* which appears in the Annals.

In May the Garden received a three year grant from the National Science Foundation. This grant, totaling $29,300, will assist the Garden with publication expenses of the Annals.

The cover of the Annals has evolved dramatically during the past two years. The design now features a broad green band on which an outline map of Panama is printed, emphasizing the Garden's work on the *Flora of Panama*. In the future the *Flora* issues of the Annals will carry the map, while general issues which include a variety of research reports, will have other designs which reflect the Garden's past and present research activities. This year, for example the sahuaro cactus *(Cereus giganteus)* will appear. This cactus was first described by Dr. George Englemann, who was very influential in founding the Garden.

In 1970 the Annals will publish papers read at the annual systematics symposium held last October in the Museum Building. The general subject of this series of papers is "Tropical Island Biogeography." Several more contributions to the *Flora of Panama* will also appear in 1970.

GARDENING IN ST. LOUIS

MARCH-APRIL

AS SOON AS ALL CHANCES of frost are past and the soil is dry enough to be easily worked, remove heavy mulches from roses and perennial beds. Work as much of the organic mulch into the soil as possible. Tamp down any plants that have been heaved by frost.

Thoroughly weed all beds. Those pesky wildings will come up easily from the moist spring soil.

Put any leftover mulch right back on the compost pile or work it in under shrubs. Care should be taken not to disturb shallow-rooted shrubs like azaleas and rhododendrons. Lime should be added to the compost pile about once a year and the compost turned with a digging fork every few weeks.

Hardy perennials such as chrysanthemums and phlox (but not iris) can be divided and reset at this time. Sow the hardy annuals, vegetables, and herbs as soon as the tiny red leaves appear on maples. The more tender annuals may be started in seed flats in late March. (Simple instructions for sowing seeds and transplanting seedlings may be obtained by sending a stamped, self-addressed envelope to the Education Department.)

A good general fertilizer for use on vegetable and flower beds is 5-10-5. Apply cottonseed meal and an acid fertilizer to azaleas and other acid loving plants.

Be sure to apply pre-emergence crabgrass killer before the apple trees bloom. Consult, if necessary, with a reliable nurseryman for a good conservative spraying program.

Plan for patio living by putting larger house plants into a bright spot so they'll be tough enough to move outside in May.

Many fruit trees may be planted before growth starts. Miniature trees that produce large fruit can fill an empty spot in the landscape. Finish pruning of trees if this has not been completed earlier.

Plant Systematics and the Garden in Winter

John D. Dwyer

THE SCENE IS A FAMILIAR ONE—the view from inside the main gate of the Missouri Botanical Garden across the ice-tipped waters of the lily pools toward the hemispherical silver-buttressed Climatron in the distance. Of course it would be more pleasant if it were late spring. But the object of our February outdoor field trip with a class of juniors and seniors in plant systematics is to show the variety of plants growing in the Garden at this time that are of direct educational value to those studying the classification of plants (taxonomy). Every detail of the trip has been carefully preplanned except for the occasional unexpected question from some brighteyed inquisitive student.

In Europe the major botanical gardens usually feature selected areas where the plants (mostly herbs and low shrubs) are neatly laid out in rows within a labyrinth of intercommunicating gravel walks. The plants are arranged according to plant families and their natural relationships; thus members of the rose family are placed close to representatives of the legume family. This is a dynamic outdoor classroom for systematic botanists as well as a show-piece for the general public.

In American botanical gardens such elaborate teaching devices have given way to more casual arrangements of plants. Our brief walk may show that this has merits pedagogically. One thing to remember is that most all of the obvious plants in a botanical garden have been placed there by professionals who have some interest in the classification of plants.

But on to our casual classroom! Above our heads is the formidable and exotically branched ginkgo tree *(Ginkgo biloba)*, a superb example of a living fossil. Except for the tender loving care of the Chinese it would be extinct and known only from rock impressions Nature made eons ago. A stone's throw away are two magnolias, one bedecked with shiny green leathery leaves *(Magnolia grandiflora)*, the other *(M. soulageana)* leafless but thrusting out plump buds symbolic of spring's rapid approach. Close by, bald cypresses

Claude Johnston

The Garden in winter can be botanically educational as well as strikingly beautiful.

stand in a stately row; it seems strange that they are now leafless for, as close relatives of the pines and spruces, one would expect them to be evergreen. Beneath these trees a creeper, the evergreen periwinkle *(Vinca minor)* and the Bulgarian ivy *(Hedra helix)* hug the ground. The ivy provides the opportunity to show the effects of cuttings on subsequent growth; the periwinkle, a member of the dogbane family, gives the opportunity to discuss the saga of drug plants.

Taxonomists are always interested in Latin names and a shrub *Euonymus alatus,* located a few steps down the path, whose twigs have wide corky wings, carries a very appropriate specific name *alatus* (the Latin for winged). And then the *piece de resistance,* a witch-hazel shrub *(Hamamelis virginiana)* bedecked with small burnished yellow blossoms! How can this shrub be in flower when ice is coating its twigs, someone asks? It is not easy to explain that the "time clocks" for flowering, built under the guiding force of evolution, millions of years ago, are not always adjusted to warmer weather. Walking through the rose garden we see an unusual greenhouse.

One of the pride and joys of the Garden is the Linnaean greenhouse, a Victorian antique of glass and red brick. Over the main doorway is a bust of the greatest of all taxonomists, the 18th century Swede, Carolus Linnaeus. How he revelled in leading botanical excursions at Uppsala University! A step into the warm greenhouse and *voilá*: a world of camellia shrubs ablaze with wax-like red and white

flowers. With a single flower in hand it is easy to show the class how the pollen producing parts (the stamens) frequently transform themselves into petals. Slipping outdoors again, we see the trellis arching over the lions head wall-fountain with its pendent wistaria pods. Comparing one of these bean-type fruits with a neighboring milkweed pod is a one minute lesson in the structure of two classical fruits: the legume and the follicle.

In the cold garden beds the leafless rhizomes of iris jut above the ground, displaying their leaf-scars in textbook style. Nearby on the turf is the drab oblong fruit of a magnolia studded with vertical crevices from which the seeds have long since fallen. The pin-point scars near the stalk of the fruit, spirally arranged, are one of the main arguments for regarding the magnolias as pioneers in the evolution of flowering plants eons ago. At every turn there seems to be a lesson to learn and still our little group is within calling distance of the main gate of the Garden.

Our next plant of interest is the waist-high evergreen shrub of *Mahonia,* laden with spikes of yellow-green buds and stiff compound leaves with 5 leaflets per leaf. Nearby is a *Yucca* whose green sword-like leaves, more accustomed to the desert, seem out of place in St. Louis. Overhead hang the graceful branches and tight-fisted catkins of Missouri's only native birch, *Betula nigra,* the river birch. The Climatron furnishes a background for the skeleton of a lone Kentucky coffee tree bedecked with clumsy pods. As we ramble down the hill past the Display House, the copper beech shows terminal buds as sharp as a thorn. Nearby is a white pine with puffs of green needles, consistently arranged in fives, a point of some importance taxonomically. The osage-orange or hedge-apple trees, readily distinguished by their orange bark, remind us that the French name for the tree, *bois d'arc* (wood of the bow) was corrupted to give us the term Ozark.

There is much to see: the button-like buds of the dogwood shrub, the spindle-shaped pods of the redbud, the white bark of the European birch—but we must finish as our watches signal the lateness of the hour. Nature's message is timeless and even in winter when we grow impatient for the soft kiss of Zephyr on the redbud blossoms, there is a world of botanical education at our doorstep. Perhaps in winter we do not notice plants and people as much, but they are alive, vibrant and worthy of our attention.

Annuals for the St. Louis Gardener

Robert Dingwall and Charles Kreher

ANNUALS, PROPERLY USED, are the glory of the summer garden. They come in the full range of colors and heights. Quick growing and soon to reward the gardener's efforts, annuals are the backbone of many gardens.

Selecting the proper varieties for our St. Louis climate is a difficult task as this particular climate places special demands upon our garden plants, as we all know.

Plant varieties that originated in Mexico or Africa are best suited for our area because of similar extremes of temperature and moisture. While some of the recommended varieties on our list are not, strictly speaking, annuals, they must be treated as such in St. Louis.

One is sometimes led down the path to floral doom by the extravagant claims of seed catalogues and ads. The Missouri Botanical Garden has been testing and using many varieties of flowers in the Linnaean Garden and other beds for years. We are including in this article some of the most successful annuals for our area, with suggestions as to exposure, soil, and care.

Sweet alyssum, because of its prostrate habit of growth and the way it produces a carpet of flowers, makes a fine plant for borders, or a filler in a formal bedding design. It prefers full sun or partial shade, in a dry, well-drained situation. A combination of White Sweet alyssum and Blue Chinese delphinium, which grows to a height of about 18", makes a nice small garden planting.

Petunias provide good color for the garden throughout the growing season; they thrive in full sun or partial shade. Sometimes certain varieties tend to become leggy and run out. This can be checked by cutting back the plants and feeding them with liquid fertilizer which will start new growth and make for compact plants. They like plenty of moisture and well-prepared soil. They are useful for tubs, borders, or mass planting.

Marigolds are the mainstay of the home gardener who likes a splash of color all summer long and well into November. Many

Paul A. Kohl

The backyard garden of Tower Grove House has, in different years, varied plantings of annuals such as shown here (foreground-vinca or periwinkle; mid-section—red petunia and snapdragon; background—mealycup sage).

people do not like the strong aromatic odor of the foliage, but neither do aphids, and thus marigolds are often recommended for interplanting as an insect deterrent. Marigolds of the dwarf French type have a good range of height and flower formation, being single, double, or semi-double. Colors range from yellow through orange to maroon. Full sun and poor soil on the dry side suit them well.

The African types are much taller, three to four feet, and are later to bloom. They should be pinched when about 10 inches high to insure branching. They prefer plenty of moisture and rich, well-prepared soil.

The zinnia, an old fashioned flower, continues to be one of the most popular choices. It is of easy culture and comes in a great variety of colors, shapes, and sizes, all flowering late into the fall season. It needs full sun and plenty of water, but the foliage should be kept dry if possible. Water early in the morning as late watering tends to bring on mildew. Climatic conditions also tend to bring about this fungus growth. Use a good fungicide to combat mildew. A feeding with liquid fertilizer every two weeks will make for vigorous plants.

Zinnia linnearis, an old time favorite little known outside the Missouri Botanical Garden, produces single, orange-petaled flowers all summer on low growing plants 10 to 14 inches in height. It is fine for borders or group plantings, and also makes good cut flowers for small bouquets.

The Cupid type of zinnia is also very nice, comes in many colors, grows about a foot tall, and is good for pots or borders. Tiny Tim (red) is a good variety.

TRIED AND TRUE ANNUALS FOR ST. LOUIS GARDENS

Name	Variety	Color	Height	Full Sun	Semi-Shade	Comments and Soil Requirements
Ageratum	Blue Cap	Blue	6″—8″	x	x	Good, well-drained soil. Remove old flower heads for continuous bloom.
	Blue Mink	Blue	6″—8″	x	x	
Alyssum, Sweet	Carpet of Snow	White	4″	x	x	Good, well-drained soil. Remove old flower heads for continuous bloom.
	Royal Carpet	Purple	4″	x		Good soil, keep on dry side, fine for borders, long blooming.
Amaranthus	Molten Fire	Crimson	3′—4′	x		Long hot summers suit them well. On the dry side.
	Joseph's Coat	Red, Crimson	3′—4′	x		
Arctotis	Hybrids	Mixed	12″	x		Good soil. Free blooming in hot sun.
Aster	Giant Branching	Mixed	2½′	x	x	Good soil, well drained.
	Powder Puffs	White				
		Pink	10″—18″	x	x	
Balsam	Double Camellia flowered	Mixed	12″—24″	x	x	Keep soil moist, feed every two weeks.
Calandrina	Speciosa	Crimson	6″	x		Average soil—heat.
California Poppy		Orange-Gold	12″—18″	x		Light, well-drained soil.
Celosia	Toreador	Deep Red	18″	x		Good soil, good for drying.
	Forest Fire	Orange-Red	18″	x		
	Rose Queen	Rose Pink	18″	x		
Cleome	Pink Queen	Pink & White	3′—4′	x		Good for backgrounds, keep on dry side.
Cosmos	Sensation	Mixed	2′—3′	x		Good soil.
Dahlias, Dwarf	Unwins	Mixed	18″—2′	x	x	Keep soil moist, remove faded blossoms.
Dimorphotheca	New Hybrids	Assorted	12″	x		Average soil—Heat.
Gaillardia	Double-flowered	Mixed	15″	x		Good garden soil.
Gerbera	Hybrids	Assorted	24″	x		Good soil. Start early. Long blooming. Cut flower.
Globe Amaranth	Cissy	White	10″	x		Good garden soil, dry.
	Buddy	Purple	10″—18″	x		
Gloriosa	Double Daisy	Golden Yellow	36″	x		Good soil. Start early. Likes heat.
Madagascar Periwinkle	Bright Eyes	White, Red eye	18″	x	x	Keep moist, stands heat.
Marigolds, Dwarf French	1. Petite Harmony	Mahogany Yellow	6″	x		Full sun, poor soil on dry side.
	2. Brownie Scout	Yellow	8″	x		
	3. Spry	Bright Yellow	9″	x		
	4. Naughty Marietta	Yellow & Red	12″	x		
	5. Tangerine	Tangerine Yellow	15″	x		

Name	Variety	Color	Height	Full Sun	Semi-Shade	Comments and Soil Requirements
Marigold, Tall African	1. Crackerjack	Mixed	2′	x		Rich, well-prepared soil. Plenty of moisture, pinch back when plants are 8″ high to insure branching
	2. Doubloons	Orange, Yellow	2′—3′	x		
	3. Climax	Orange, Yellow	2½′—3′			
Nicotiana	Sensation Hybrids	Assorted	18″	x		Good soil.
Petunia	1. Pink Velvet	Salmon Pink	10″	x	x	Any good garden soil, kept fairly moist.
	2. Pink Cascade	Pink	10″	x	x	
	White Cascade	White	trailing			
	3. Mariner	Blue	12″	x		
	4. Sugar Plum	Lavender Rose	12″	x	x	Fine for window boxes or pots.
	5. Paleface	White	15″	x	x	
Phlox Drummondi	Globe mixed	Assorted	6″	x		Good soil.
	Twinkle mixed	Assorted	6″	x		
Portulaca		Mixed-rich shades		x		
Snapdragon	Bright Butterflies	Mixed	2′—3′	x	x	Rich soil, well-drained, plenty of water.
	Floral Carpet	Mixed	6″—7″	x	x	
	Rocket	Mixed	2′—3′	x	x	Stands hot summers well.
Salvia	Bon Fire	Scarlet Red	2′	x		Good garden soil.
	St. John's Fire	Scarlet-Red	10″	x		Early flowering.
Tithonia	Torch	Orange Red	48″	x		Rank grower.
Venidium	Monarch of the Veldt	Assorted	30″	x		Hot, sunny, dry area.
Verbena	Ideal Florists	Mixed	12″	x	x	Give plenty of water.
Zinnia, Dahlia type	1. State Fair Tetraploid	Pink	3′	x		Good soil, plenty of moisture, subject to mildew, use fungicide.
	2. Exquisite	Pink	3′	x		
	3. Dream	Lavander	3′	x		
	4. Polar Bear	White	3′	x		
	5. Will Rogers	Scarlet Red	3′	x		
	6. Salmon Queen	Salmon	3′	x		
Zinnia, Cactus type	F1 hybrid Zenith	Mixed	2′	x		Plenty of water, longer blooming period. Subject to mildew.
Zennia, Single-flowered	Zinnia Linearis	Orange	10″—14″	x		Semi-dwarf, long lasting flowers, good for small bouquets.
Zinnia, Cupid type	Tiny Tim	Red	12″—18″	x		Semi-dwarf, long lasting flowers, good for small bouquets.
Zinnia Lilliput or Baby Pom Pom	Rose Gem	Rose	12″—18″	x		Semi-dwarf, long lasting flowers, good for small bouquets.
	White Gem	White				

The Lilliput or Baby Pom Pom zinnias are taller in growth than the Cupid variety. They grow 12 to 18 inches in height, are more branching, and produce flowers 1 to 1-1/2 inches across.

For a splash of brilliant red, plant scarlet sage *(Salvia splendens)*, which, although rather slow to start from seed, may be purchased as established plants from a garden center. The bushy plants with their scarlet spikes above the dark green foliage make quite a display. However, one must be cautious about using them as they may clash with other flowers. *Salvia* is handsome as a border along a driveway or as a mass planting edged with white petunias such as Paleface. Well-drained soil, not too rich, will suit them. Remove the faded flower stalks as this will help them to continue blooming.

Gazanias are very attractive. They like our hot summers, as they come from Africa. Good sandy soil on the dry side with adequate drainage suits them. They should be started early indoors.

A good many of the annuals may be sown in open ground when the weather and soil become warm. Examples of annuals that can be easily grown from seed are: zinnias, marigolds, cosmos, gaillardia, balsam, globe amaranth, celosia, amaranthus, and sweet alyssum.

The following are best started in flats, due to a longer period of growth before flowering: snapdragons, ageratum, petunias, asters, dianthus, gloriosa, daisies, Madagascar periwinkle, nicotina, verbena, salvia, impatiens, and sultans balsam.

Vegetables can be very attractive in a flower garden. Tiny Tim tomatoes, green pepper plants, leaf lettuce, and parsley are but a few of the vegetables that have attractive foliage plus the bonus of giving the gardener truly fresh salad ingredients. The tiny scarlet tomatoes and shiny green peppers are fully as attractive as flowers. Try a lettuce or parsley border for a good contrast in texture and color. If you really feel daring, a cluster of one of the miniature sweet corns or strawberry popcorn can be worked into an annual bed.

Annuals do not grow well in full shade. Plants suitable for semi-shaded areas are: begonias, impatiens, lobelia, torenia, coleus, and periwinkle.

Check with local nurserymen and seed houses to see what is available in the suggested list. If you plant flowers that are basically suited to our climate, you will achieve a more beautiful garden with less effort.

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Visit Your Missouri Botanical (Shaw's) Garden

The Missouri Botanical Garden's main entrance is at Tower Grove and Flora Place. The Garden is served by both the Sarah (No. 42) and the Southampton (No. 80) city bus lines.

The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

May 1 through October 31 . . . . 9:00 a.m. to 6:00 p.m.
November 1 through April 30 9:00 a.m. to 5:00 p.m.
Sundays and Holidays . . . . . 9:00 a.m. to 7:00 p.m.

For Tower Grove House:

May 1 through October 31 . . . . 9:00 a.m. to 5:00 p.m.
November 1 through April 30 10:00 a.m. to 4:00 p.m.

The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

Support your Garden and take part in Garden activities through the Friends of the Garden. Information may be obtained from the Main Gate or by mail or phone (865-0440).

MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVIII NUMBER 3

MAY-JUNE 1970

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From the Director

THE PEOPLE OF AMERICA suddenly are coming to the realization that they have fouled their own nest. Man, the dirtiest of all animals, knows now that the spaceship Earth has limited resources, limited space, and a fragile green surface upon which he is completely dependent.

Ecology has suddenly become the "in" word. However, the public is using the words ecology and environment interchangeably and often without distinction. Ecology is the study of the relationships between organisms (plants and animals) and their environment. The science of ecology began about 1900 but the word itself was used by Darwin, Haeckel, and others earlier in the nineteenth century. By the end of the first decade of this century there were many ecologists in America who were teaching and doing research in ecology, including my father. The Ecological Society of America was established in 1915 and today has a membership of 3500 professionals.

We live in the environmental theater and the play includes the ecological scene, the geological scene, the geophysical scene, the sociological scene, the economic scene, and others. Ecology is just one body of knowledge among many that concerns the world in which we live; e.g. the interaction of plants and animals with their environment, with one another, and including the influence of man. If your concern is with pollution, then your concern is for the quality of the environment. If your concern is with the effects of pollutants on plants or animals, then your interest is ecological. If you are studying how pollutants affect man, then your concern is with human health. Meteorologists study the weather, an extremely important component of our environment. A meteorologist is not an ecologist unless his objective is to understand the effect of weather on plants and animals.

The field of ecology is a very distinguished profession with a substantial history of demonstrated success including the application of ecological principles to wildlife management, land use, forestry, agriculture, and other fields. Many of the immediate problems faced by man are environmental. Pollution is a prime example. However, the ultimate confrontation between man and Earth's ecosystems is ecological; for man must learn to live in close cooperation with the plants and animals of this planet.

David M. Gates

MISSOURI BOTANICAL GARDEN BULLETIN

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Illustration is from a woodcut of the great blue mountain starwort *(Aster alpinus)* in John Parkinson's *Theatrum Botanicum* published in London, 1640.

The Great Blue Mountain Starwort

Carla Lange

OUR COVER THIS MONTH is from a woodcut of the Great Blue Mountain Starwort in John Parkinson's *Theatrum Botanicum*. In his description of the virtues of this plant, Parkinson says "that the purple leaves of the flowers boyled in water, was held to be good for the paines and sore in the groine" and "likewise the dryed flowers, to be taken into the right hand of the patient, bound to the place that is grieved, it taketh away inflammation in those places, it helpeth children also that have the falling sickness; and those that are troubled with the Quinsie. It helpeth an hot stomacke, the inflammations of the eyes" and "it helpeth them that are bitten by a mad Dogge; it consumeth the swellings of the throat, and driveth away Serpents if it be burned. It hath not only a digesting, but also no small cooling quality, and repressing, being of a mixt property like the Rose".

The Great Blue Mountain Starwort or *Aster alpinus* belongs to the family of the *Compositae*. It is native to Austria, Switzerland, and the Pyrenees. In its native habitat it flowers about the end of May and beginning of June and, in its wild state, it acquires a height of about four inches.

The plant was introduced and cultivated in England in 1759 by Philip Miller, author of the famous *The Gardeners Dictionary*. In cultivation it reaches a height of eight to nine inches and its blossoms are large and full. At the top of each stalk is one large blue flower. It can easily be propagated by parting its roots in the autumn, and may be kept in pots or planted in the open in tightly packed soil.

WHAT'S IN A WORT?

Daniel F. Austin

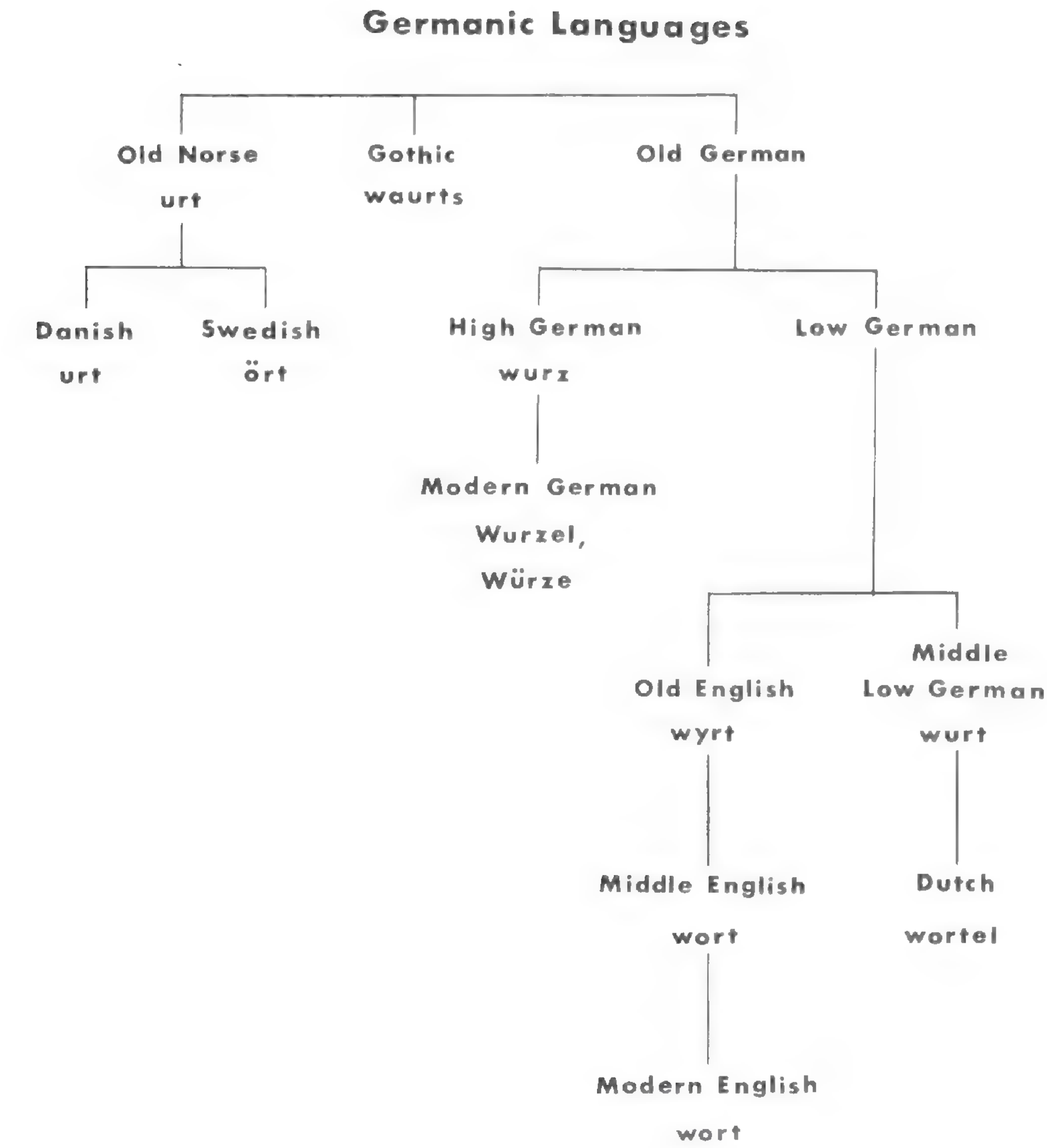
EVER WONDER WHERE such terms as *liverwort* and *spiderwort* originated? The first of these common names comes from the period when the doctrine of signatures was in vogue and refers to the supposed medical properties of plants as revealed by their shape.[1] The other name is derived from the appearance of certain plant structures.

The first part of such common names is usually obvious enough, but the last is not always as obvious. The ending -wort in these common names, as one might suspect, means plant. Thus, when translated, the common names become liver-plant, or a plant shaped like and supposedly good for the liver; and spiderplant, or a plant which has hairy filaments resembling spider legs. The ending which we translate to mean plant comes from similar words in the old Germanic segment of the Indo-European Languages and their derivation follows the scheme in the diagram.

Although these words have kept somewhat the same meaning in numerous modern languages, they have taken on different meanings or forms in others. The Danish *urt*, originally meaning plant or root, today signifies weeds. German has two words apparently derived from *wurz; Wurzel* and *Würze*. The first word means root and shows close relation to the Gothic word *waurts* which meant the same. The spelling variation *Würze* has come to mean a seasoning or condiment and probably first referred to a root used to season food.

The term *wort* rarely occurs alone in modern usage in the United States, but it is still listed in Webster's Dictionary where he notes

1. For a discussion of the doctrine of signatures see: R. E. Woodson, Jr. 1926. Missouri Bot. Gard. Bull. *14:97-102. pl. 32*



The derivation of the suffix, -wort, is shown in this diagram.

that it is a "plant or herb of any kind; esp., a potherb. originally a plant or root". The term is now mostly used in compound words to form the common names of plants. Fernald, Kinsey & Rollins's book, *Edible Wild Plants*, lists about fifteen wild plants whose common names end in -wort, and Fernald's edition of *Gray's Manual* lists about sixty such names.

Although common names are often troublesome to plant taxonomists, they provide interesting glimpses into the past and may actually be of help to those seeking medically useful compounds. □

GARDENING IN ST. LOUIS

May and June

ANNUALS SOWN IN GARDEN beds should be thinned to single plants when a couple of inches high. Flats of annuals can be planted beginning in mid May. Mid June is a good time to start seeds of perennials and biennials for next year.

Most gardening work, including cutting of house flowers, is more successful when done before the heat of the day, but many people like to plant in the early evening, giving tender plants a whole night to recover from any transplanting shock.

If you pull all weeds before ten each morning, you'll never have an over-bearing weed problem. A good program of organic mulching will not only help keep the weeds down and retain soil moisture, but will also enrich the soil as it is worked into beds.

Feed roses a handful of rose food once a month or the equivalent in liquid fertilizer every two weeks, and make sure they receive what would amount to one inch of rainfall each week. Clipping spent blooms will increase flower production of roses as well as other plants.

Prune evergreens such as pfitzers and yews when new growth is three inches long. Spring flowering shrubs can be pruned after flowers fade.

Encourage bluegrass and discourage weeds by mowing lawn regularly and no shorter than three inches.

Periodic application of granular or liquid fertilizer to annuals, perennials, and vegetables combined with maintenance of soil moisture will maintain blooming vigor and enhance production.

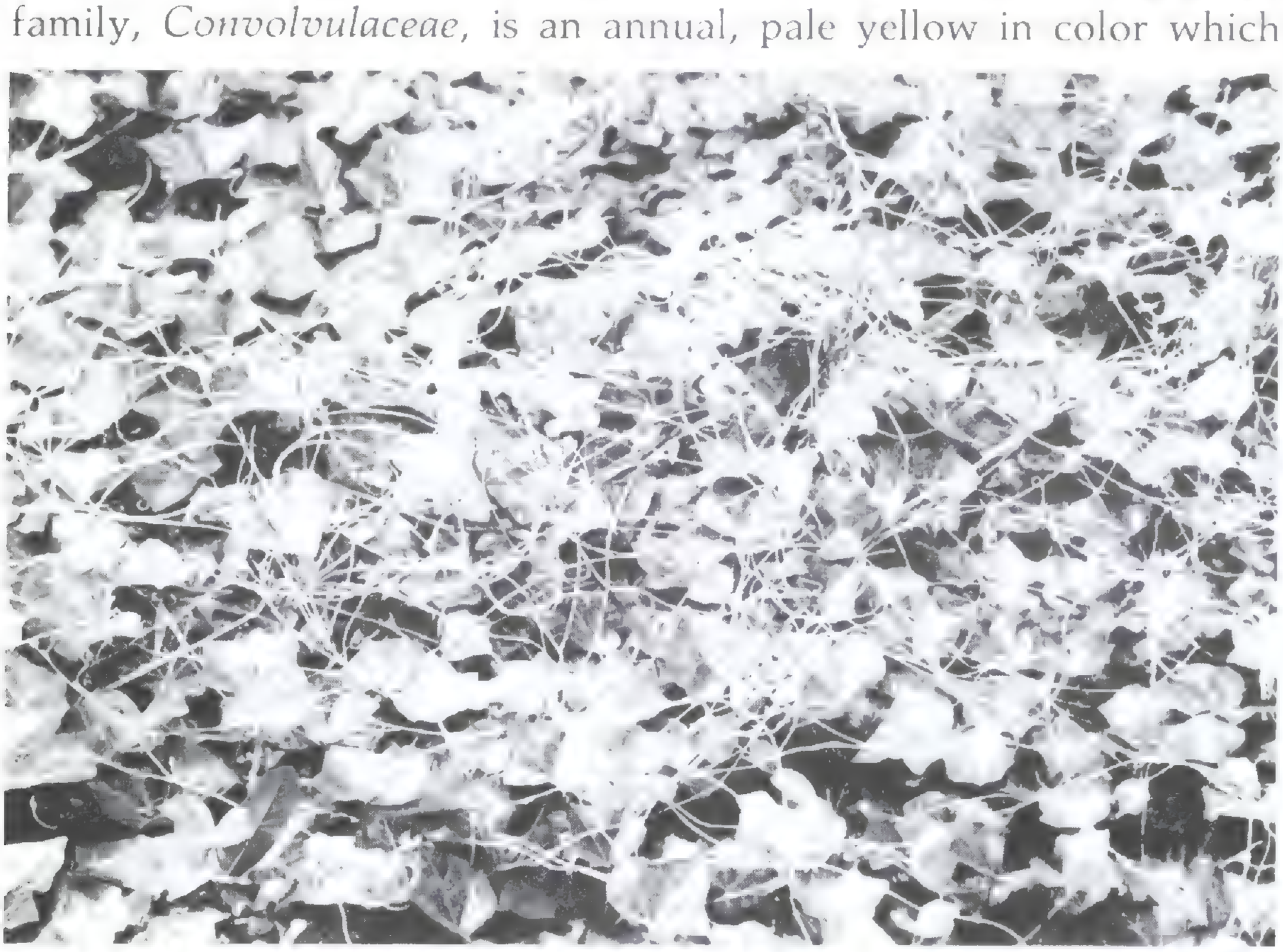
Be observant for early signs of disease infection and insect invasion, and take pains to get a correct diagnosis and appropriate remedy. Reasonable and effective substitutes for DDT are available. A Pyrethrum-Rotenone combination is a good general spray. Two others are Diazinon for mites, clover mites, and aphids; Sevin for bagworms, caterpillars, and box elder bugs. □

FIELD DODDER

Paul A. Kohl

FIELD DODDER IS A curious and interesting plant that suddenly appears in gardens where it has never been known to grow before. Whether the abundant rains in the summer of 1969 could have caused this plant to be more prevalent than in other years is not known, but it would seem probable since the Garden had several requests for the identification of this vine.

Dodder is a true plant parasite in that it derives its nourishment from the host plant on which it spreads by attaching suckers to the stems. The string-like vine, which is a member of the morning-glory family, *Convolvulaceae*, is an annual, pale yellow in color which



Paul A. Kohl

Field dodder, a true parasite of the plant world, shown here on English ivy.

Paul A. Kohl

Dodder flower buds and open flowers.

bears clusters of small whitish flowers. When the seed germinates the vine spreads over the nearest plant but, if it fails to find a host plant, it dies as it has no roots in the soil. The term field dodder has been applied because there are species that attack crops like clover, alfalfa, flax, and Korean lespedeza, only occasionally invading the flower garden.

The only way to eliminate dodder is to pull all of the vines from the host plant, particularly all of the flower clusters, to prevent the plant from re-seeding.

The dodder in the illustrations, which shows an infestation in a bed of English ivy, is probably *Cuscuta pentagona* but since there are numerous species with only minor differences in structure it might be *Cuscuta glovonii* which Gray's Manual of Botany considers the "commonest of our species." □

WHAT'S INTERESTING ABOUT OHIO BOTANY?

Will H. Blackwell, Jr.

FROM JUNE 1967 through August 1968 I was at the Missouri Botanical Garden as a postdoctoral fellow working on the Flora of Panama. During this period I was engaged in many interesting activities related to tropical plants, including a trip to Panama with several members of the herbarium staff of the Garden. I prepared treatments of three families of flowering plants for the Flora of Panama. In St. Louis, I received daily enjoyment from the lovely and varied surroundings of the Garden itself. Each season possessed its own special charm in the flowers or attractive foliage which appeared.

After completing my stay at the Garden, I took a teaching position at Miami University in Oxford, Ohio. All the beauty of the Garden and the interesting work on tropical plants had to be left behind. What by comparison could be so interesting? Specifically, what could be interesting about botanizing in Ohio? In all candor I thought myself going to a botanical graveyard. At first glance the botany of the state appears dull indeed. However, I was soon to discover the magnitude of my misconception. There are many things of botanical interest in Ohio, though not readily apparent to the casual observer.

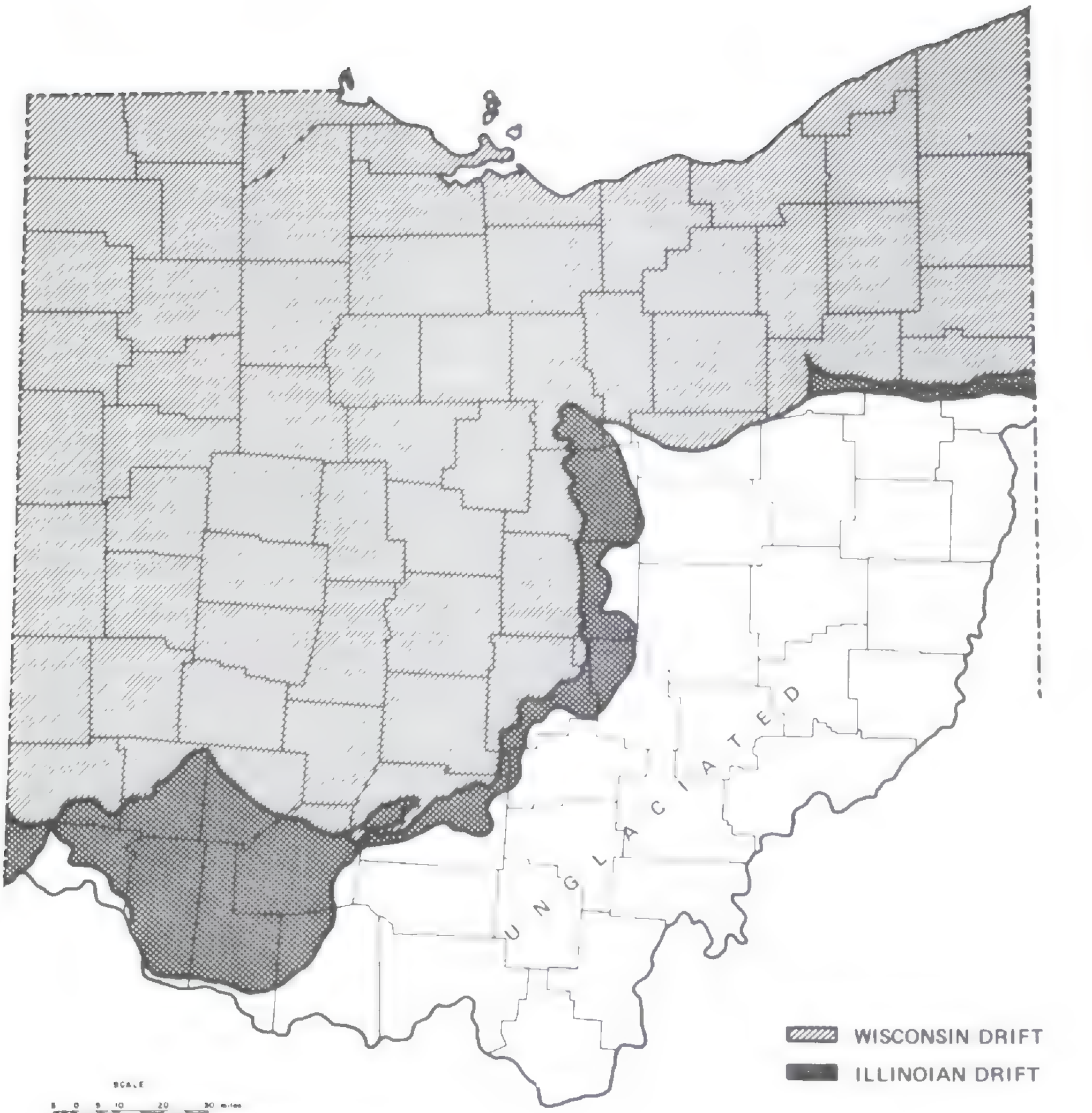
The botany of Ohio, as that of Missouri, is rather well known in a descriptive sense. Numerous books and papers deal with the subject. Little is left to the adventurer who delights in discovering and describing new species or varieties of plants. In terms of interesting topographic features, Ohio would not rank high among the

states of the Union. Ohio cannot boast of alpine meadows, mountain slopes covered with towering coniferous forests or rocky, algal covered ledges jutting ruggedly into surf. Alarmingly, the face of Ohio's natural vegetation has been so drastically altered by man as to be scarcely recognizable. Ohio is a heavily populated state; most of the land is used either in agriculture or industry. There has been little active conservation of biological resources. Natural areas to which a botanist may turn are few and far between. Again the question already posed, what is botanically interesting about a situation like this? What is there to intrigue the devoted botanist, professional or amateur?

Actually the flora of Ohio is an extremely varied one, at least under natural conditions. There are components of the eastern deciduous forest. Elements of the prairies of the Great Plains province are found in limited areas. In addition, some of the most interesting and unusual distributions of plants anywhere in the world may be observed in Ohio. Many species continuously distributed throughout the southeastern United States suddenly terminate their range in southeast Ohio. Isolated colonies of northern or boreal species such as white cedar (*Thuja occidentalis*) occur in central and southern Ohio (and less frequently in northern Ohio). Other species are uniformly distributed over northern, central and western Ohio, and in some cases southeastern Ohio, but do not show themselves in the southwest corner of the state.

Though some might first hazard the guess that the distributions mentioned are somehow climatically controlled (we are used to thinking of major vegetational regions as owing their existence to a particular set of climatic factors), this is probably not the explanation, at least in the majority of cases. Certainly we would be hard pressed to explain the disjunct appearance of boreal species in southern Ohio by consulting climatic factors alone. The answer to these puzzling distributions in all likelihood lies in the topography and history of the land. The study of botany in relation to physiography has provided significant insights into the reasons why Ohio plants grow where they do.

In late Tertiary time, more than one million years ago, most of the eastern United States including Ohio was covered by a rich deciduous forest resembling the wild undisturbed regions of the Appalachians. Important in the development of the present day


UNGLACIATED
WISCONSIN DRIFT
ILLINOIAN DRIFT
SCALE
0 5 10 20 30 miles
Modified from glacial map of Ohio.
U S Geol Survey Misc Geol INV Map I-516
by R P Goldthwait G W White and J L Forsyth

GLACIAL MAP OF OHIO

The last two advances of continental glaciers are of real significance to Ohio's vegetational patterns.

vegetation of Ohio was the advance of great ice sheets, the continental glaciers, at intervals during the past million years. This, the Pleistocene period, is often referred to as the Ice Age. Although four advances of glacial ice probably occurred, only the last two, the Illinoian and later the Wisconsin glaciation, are of real significance to Ohio's vegetational patterns.

The important point is that the glaciers totally destroyed all vegetation in the area they occupied. The extent of the last two glaciations is shown on the accompanying map. Although the majority of the land surface in Ohio was glaciated, the southeastern part of the state (primarily the Allegheny Plateau region) was not. It is likely that the hills and valleys of the unglaciated region of the Allegheny Plateau in Ohio have been continuously forested since Tertiary time, except where man has intervened. As the glaciers melted and retreated they left behind a scarred land surface blanketed by the bare rocks of various sizes which they deposited. Deep glacial drift covers the bedrock over much of glaciated Ohio and constitutes the major soil-forming rock of the region. It is of two ages, the more recent Wisconsin drift overlying the older Illinoian drift. Due to a further southern extension of the Illinoian glaciers, Illinoian drift is exposed south of Wisconsin drift, particularly in southwestern Ohio as the so-called Illinoian Till Plain. The Wisconsin glaciers retreated for the last time about 10,000 years ago. Since that time the till plains, comprising the single largest physiographic area in Ohio, have been continuously available for plant colonization. It should be understood that plant invasion did not happen overnight as soil formation was a necessary requisite.

Glaciated Ohio land has been open to plant migrations from the southeast, the southwest and the west. All have occurred, with those from the southeast and southwest being most significant. Some plants such as beech *(Fagus grandifolia)*, sugar maple *(Acer saccharum)* and red bud *(Cercis canadensis)* readily migrated onto glaciated land. Others such as sweet gum *(Liquidambar styraciflua)* have invaded but have not gone deeply into glaciated territory and are definitely less frequent north of the glacial boundary. A few species, such as shingle oak *(Quercus imbricaria)*, are just coming in at present, making their way up river valleys into dissected areas of the drift. Many species, sweet buckeye *(Aesculus octandra)*, white basswood *(Tilia heterophylla)*, Virginia scrub pine *(Pinus virginiana)*, Canada lily *(Lilium canadensis)*, have been totally or virtually unable to migrate beyond the glacial border, particularly the limits of Wisconsin glaciation. The reasons for these distributions are not totally understood, though in many cases they are related to species tolerance of such factors as poor drainage, calcareous soils, immature soils or early successional stages.

Equally fascinating are distributions like that of the large white Trillium *(Trillium grandiflorum)*. This attractive spring flowering perennial is generally distributed over glaciated and unglaciated Ohio except in the southwestern corner where it does not penetrate the Illinoian Till Plain. An adequate explanation for range termination of this species southward at the Wisconsin boundary has not been offered. The American basswood or linden *(Tilia americana)*, occurs uniformly on Wisconsin drift, but does not occur on unglaciated land and has had little success on the Illinoian till. The beginning of the Illinoian till likewise marks the approximate southern limit of the Beech-Maple forest region.

A possible explanation of disjunct distributions of plants like white cedar and swamp birch *(Betula pumila)* may be deduced from their occurrence in Ohio primarily in calcareous bogs, such as Cedar Swamp in Champaign County. It is not too far fetched to assume that such species migrated northward as the Wisconsin ice sheets melted, perhaps persisting locally in a few areas where bogs developed in depressions in the drift.

The presence of prairie disjuncts of the Great Plains flora in west-central Ohio is explained by an eastward extension of an arm of the prairie into Ohio three to five thousand years ago during a warm dry period developing after glacial retreat. The Lynx Prairie Preserve in Adams County in unglaciated southern Ohio is actually thought to be of interglacial rather than post-glacial age, but precise dating is difficult. Such characteristic prairie inhabitants as the prairie-dock *(Silphium terebinthinaceum)*, big bluestem *(Andropogon gerardii)* and side-oats grama *(Boutelous curtipendula)* may be observed during the appropriate season. It is indeed a sad commentary on the activities of man that most of the relic colonies in Ohio, both boreal and prairie, have either been destroyed or are in the process of destruction at present. The Lynx Prairie Preserve, purchased by the Nature Conservancy through the diligent activities of the Ohio Chapter and deeded to the Cincinnati Museum of Natural History, is a heartening exception to this tragedy. □

JAPAN DÉJÀ VU

Erna Eisendrath

EVERYONE KNOWS that the Japanese garden represents a highly perfected minor art, that Japanese flower arrangements demand the most skilled hand and practiced eye; but very few of us know much about the natural vegetation of those enchanting islands. To learn more in the field is difficult because the only *Flora of Japan* in English (Jisaburo Ohwi, Smithsonian Institution, 1965) weighs well over five pounds, and is hardly practical to carry overseas!

Even without such guidance, one familiar with our native vegetation is almost immediately aware of a haunting sense of *déjà vu*; the natural vegetation of Japan is in a number of ways so similar to our own that it presents immediate challenges to the botanist.

My first attack of *déjà vu* occurred while visiting the beautiful shrines set in the magnificent Japan cedar *(Cryptomeria japonica)* forest of Nikko National Park, just north of Tokyo. Except for the shrines themselves, and the hordes of Japanese children visiting them, I could well have imagined myself to be among the redwood trees of Muir Woods, just north of San Francisco. Botanically this was a bit far-fetched, for although *Cryptomeria* and *Sequoia* are both members of the small plant family, *Taxodiaceae*, they are not so similar as to be mistaken for one another. On historical grounds, however, I was firmly based.

Asa Gray, in the mid-nineteenth century, had noted marked similarities between the flora of Japan and our own, particularly that of our eastern seaboard. His observations are well known, not only because they contributed greatly to the rapidly developing science of plant geography, new during his day, but also because they played a large role in the thinking of Charles Darwin.

In the spring of 1855 Darwin had written to the American:

> I have for several years been collecting facts on 'variation', and when I find that any general remark seems to hold good amongst animals, I try to test it in Plants.

Photocopy by Shaw Camera

The natives of Shimoda were excited and frightened at seeing Commodore Perry's ships anchored in their harbor in May, 1854. The event is depicted in this photocopy of a Japanese painting.

In connection with this testing of variation, Darwin requested that Gray note in his *Manual* of the "flowering plants and ferns of the central and northeastern United States and adjacent Canada" which plants might also be found in eastern Asia. "What I want," he wrote, ". . . is to have marked 'close species' in a Flora."

The stimulus thus furnished by Darwin led Gray toward conclusions strikingly close to the Britisher's own theories. In December, 1858, a few years after Darwin made his request, Gray read a most important paper before the American Academy of Arts and Sciences, a paper popularly known as his "Japan Essay."[1] In it he had the following to say about close species:

> The natural supposition is that individuals of the same kind are descendants from a common stock, or have spread from a common centre; and the progress of investigation, instead of eliminating this preconception from the minds of botanists, has rather confirmed it.

The intellectual cross-fertilization between the minds of Darwin and Gray, over a period of years, yielded rich results indeed. Such historical connections combined with a botanical sense of *déjà vu* can lead to the forging of intellectual links that seem quite improbable.

During my trip to Japan I became aware of such links among Asa Gray of Harvard, Japan's Tokugawa Shogunate[2], Commodore Perry of the United States Navy, as well as Charles Darwin and *The Origin of Species*.

My more improbable botanical-historical links were actually to be forged only after travelling to the farthest tip of Japan's Izu Peninsula which juts into the sea south of Mt. Fuji. The peninsula, along with the stunning mountain area that includes Mt. Hakone as well as Fuji, forms another of Japan's National Parks. Shimoda, in the southeast corner, is of interest because it was into the small harbor of Shimoda that American ships first sailed when Japan was opened to United States trade by Perry's efforts culminating in the treaty of March 31, 1854.

[1] *The "essay" was published in the* Memoirs *of the Academy (n.s., VI, 1859, pp. 377-452) under the title "Diagnostic Characters of New Species of Phaenogamous Plants, Collected in Japan by Charles Wright."*

[2] *From the 12th through most of the 19th century, the effective power and actual administration of Japan were in the hands of hereditary military dictators holding the title of "Shogun". In the early years the shogunate was held by several families; but from 1603 until 1867 the Tokugawas maintained control by means of a centralized feudal bureaucracy. When this finally collapsed, the royal family, which had maintained the empty formality of imperialism throughout the shogunates, was restored to power. It is from this so-called "Meiji restoration," in 1867, that the development of modern Japan is dated.*

Aboard one of these was the botanist, Charles Wright, sent by our government to accompany its North Pacific Exploring Expedition; and it was the plants that Wright collected around Shimoda (and the port of Hakodadi), in 1855, that served as raw material for that "Japan Essay" of Asa Gray's that I mentioned before. And, since the "Japan Essay" was so important a cog in the rationale behind Darwin's great biological synthesis, the theory of evolution, it is not difficult for the botanical historian to forge links that connect Gray not only with Darwin himself, but with Commodore Perry; nor is it too difficult to link Perry up with Darwin. But, you well may ask, however does one fit the Tokugawas into this series?

To do so with botanical justification, one must refer back to a book review written by Asa Gray in 1840. Gray noted therein that Dr. Zuccarini's *Flora Japonica* (Leyden, 1839) gave him grounds to suspect marked similarities between the Japanese flora and our own. Again in 1846, and in the same publication in which his review had appeared, Gray published an article entitled "Analogy Between the Flora of Japan and that of the United States." For historical reasons, however, Gray's botanical work in this area was of necessity limited; he was unable to obtain plant materials from Japan because the ruling Tokugawa Shogunate had almost totally isolated those beautiful islands from contact with the western world; it was only when the shogunate began to weaken that Perry was able to break down this long-standing barrier. Ergo: the weakening Tokugawas permitted Perry to open the way for a botanist who furnished plants to Asa Gray who, in turn, used them to furnish Darwin with evidence to support his thinking about the Origin of Species!

The chain of thinking first stimulated by a botanical attack of a sense of *déjà vu* at Nikko, closed with a snap when it became associated with the historical references of Shimoda. □

OLIVES, PAST AND PRESENT

Susan Verhoek-Williams

THE BLACK AND GREEN OLIVES reposing on relish trays and in martinis today come from a long line of distinguished forebears. This line extends back into the Neolithic period, to the span of time between the 7th and 5th Millennia BC. During this period the wild olive grew from Palestine and Syria westward around the Mediterranean into Greece on the north and Africa on the south. Primitive peoples living at the eastern end of the Mediterranean slowly began to use the fruit of these trees as a source of fat in their diets. Gradually these ancient peoples began to select the offspring of the most tasty or oil rich trees and cultivate them. By the 4th Millenium BC the ancestors of present day olives were an important crop to the people in the land of Israel. Archeologic explorations of sites dating from that period yield pits of the cultivated type of olive as well as presses for extracting the oil and jars for storing it.

Stephen Williams

Today's table olives. (by permission California Canners and Growers.)

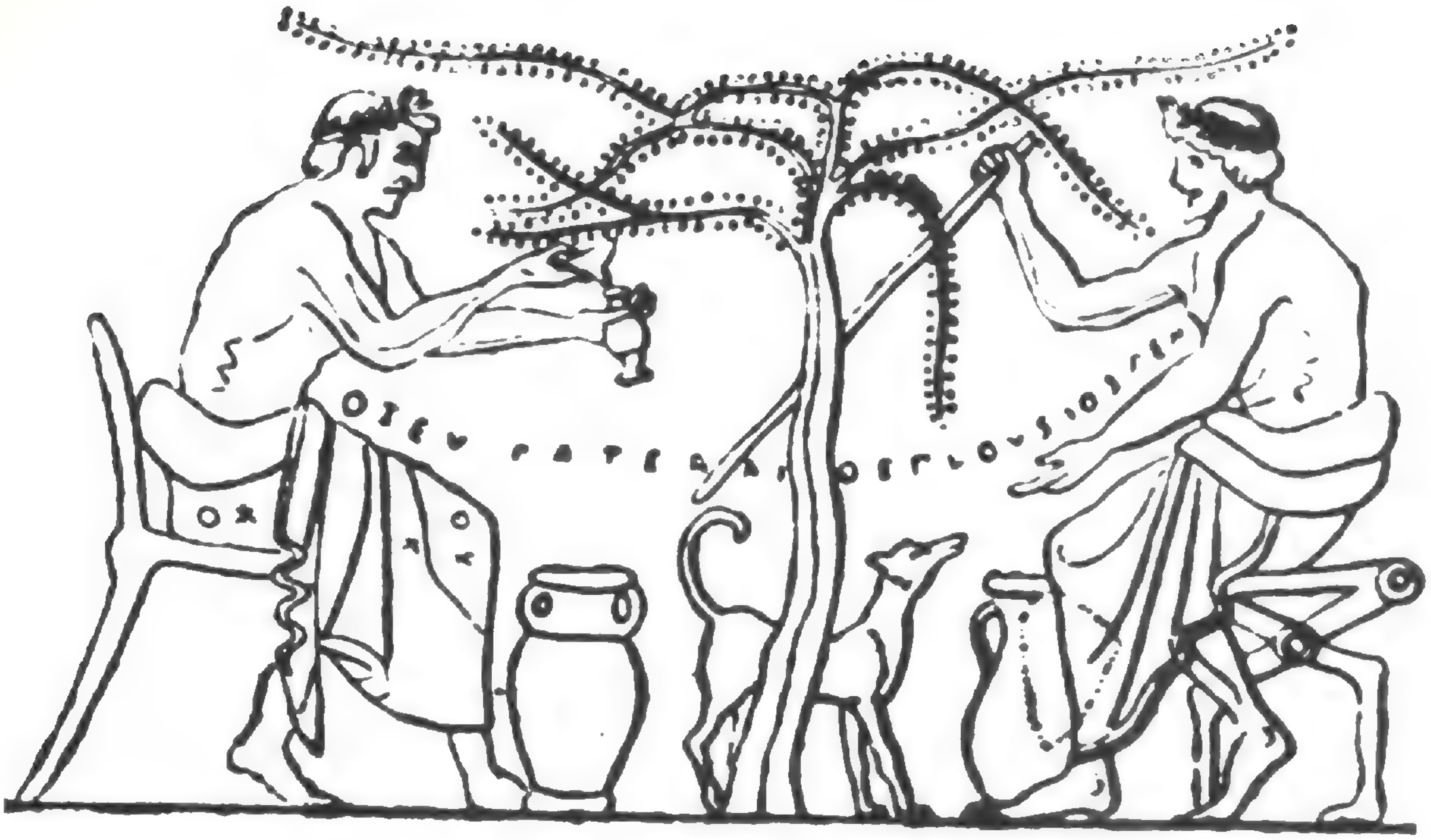
Between 3000 BC and 1800 BC the practice of olive cultivation expanded into Egypt and across North Africa. Perhaps the impetus for this move was the success and great importance of the crop in its Palestinian birthplace.

As evidence of its importance, the olive is mentioned innumerable times in the Hebrew writings. In Exodus 23:10-11 there are instructions concerning the olive harvest: "And six years thou shalt sow thy land and shalt gather the fruits thereof; but the seventh year thou shalt let it rest . . . that the poor of thy people may eat . . . In like manner thou shalt deal with thy vineyard, and with thy olive yard." Deuteronomy 8:7-8 cites the olive as one of the blessings of the land of the Hebrews: "For the Lord thy God bringeth thee into a good land . . . a land of wheat . . . a land of oil olive and honey." Not only was the olive mentioned in promises of prosperity ". . . He will also bless the fruit of thy land, thy corn and thy wine and thine oil" (Deut. 7:13); it was also featured in the calamities called down upon the people by the prophets "I have smitten you with blasting and mildew: when your gardens and your vineyards and your fig trees and your olive trees increased, the locust devoured them . . . saith the Lord" (Amos 4:9).

The loss of olive groves would indeed be a calamity. Not only did the olive provide one of the main sources of food, it was the source of oil for lamps and anointing, its leaves were used as fuel, fodder and writing paper; its wood was used in basketry, in thatching for booths for the Festival of Tabernacles, and for building. The doors to the oracle of the Temple were of olive wood.

So abundant was the olive that it formed one of the main materials of commerce for the Hebrews. Ezekiel and Hosea both report that olive oil and fruit were exported to Egypt, Tyre, and Sidon. Tyre and Sidon were major port cities of the Phoenicians. Egypt was forced to import olives and oil because her own olive trees were inferior producers.

Early hieroglyphs indicate that some oil was imported to Egypt from North Africa, but later certainly most of it came from the east. In 1800 BC the Story of Sinuhe mentions Canaan as a land abundant in olives. In 1482 BC and the years following, the campaigns of Thutmosis III into Canaan returned to Egypt with a booty of olive oil. Two hundred years later Egypt was still receiving oil from Syria and Israel, this time as gifts to Rameses III. The need for olive oil had



Stephen Williams

Collecting yesterday's olives and oil. Drawn after an ancient Greek painting; from A. Coutance, *L'Olivier*, Paris, 1877.

increased in Egypt because the troops demanded oil to use as a body lotion.

Across the Mediterranean, the first Greek mention of the olive is by Homer in 900 BC. Homer tells of olive oil being imported to Greece. However, Homer uses the Greek word for olive, *elaion*, indicating that the Greeks knew the olive at home before it arrived from abroad. If that were not so, Greek merchants inquiring the name of the new fruit would have been told by the Semitic salesman at the dock that it was *zayit*, and that word or a variation of it would have come down to us today instead of "olive" and the related word "oil." As added evidence of the antiquity of olives in Greece, there are olive leaf designs dating from 1200 BC discovered in an ancient cemetery in Syracuse.

It is reasonable to assume that increasing contact between Greece and the older civilizations of the Mediterranean resulted in the introduction of superior cultivated varieties from the East and South. These introductions may be the source of the legends that the olive was brought to Greece by Hercules or given by Athena in the contest over the naming of Athens. (It is obvious who won. Poseidon gave a fiery horse, symbol of war, but the people decided in favor of Athena's gift, symbol of peace and plenty.)

The introduction of the cultivated olive into Italy is better documented. It was taken there from Greece before the time of Tarquin the Elder in 627 BC. In both of the civilizations the olive grew well and the fruit and oil were staples in the diet of the poor. Here in addition the olive reached its highest appreciation as a delicacy. There were nine or twelve varieties, each with its own special characteristics of taste, color, shape and oil content. The Greeks had a choice of olives preserved in either vinegar, salt, or brine and perhaps seasoned with fennel or mastic, the resinous flavoring from a native Mediterranean tree.

The Romans adopted the Greek's recipes and elaborated on them until preserving olives became an art and the mention of an olive was enough to make Roman gourmets quiver with delight. Horace, in one of his poems, affirms that of all the adornments of succulent tables he prefers olives, even to the hen of Africa or the pheasant of Ionia. Horace was not alone in his passionate appreciation for olives. Pliny the Younger described a regal dinner at which were served cress, eggs, garlic, olives and beets. Martial, in extending a dinner invitation to a friend, included a menu to ensure acceptance of his offer. Part of the attraction was the hors d'oeuvres: "cheese from Velabre, hardened by fire and olives from Picenum, wrinkled by the cold."

Cold treated olives were one of the favorites of the Roman gourmets. The olives were left to become very ripe and then allowed to freeze and become bleached and wrinkled.

Many of the Roman recipes were designed not only to remove the natural bitterness of the olive and to preserve the fruit but also to put some extra flavoring into the delicacy. There were special treatments for ripe, green, and over-ripe olives. Some of the olive varieties were picked ripe, washed in warm water and then preserved in new beer, wine, or honeyed water and seasoned with leek, mastic, fennel, rue, mint, anise, oregano, parsley, or cypress and olive leaves. Olives picked before they ripened were preserved either in salt, oil, vinegar or beer and seasoned with any of the flavorings used for ripe olives. Very ripe olives were allowed to freeze or were preserved in wine, sometimes with the addition of vinegar or honey. These olives, after curing in the liquid for 40 days, were removed and partially dried between layers of salt.

One of the recipes written by the Roman Palladius suggested

using well sifted ashes in part of the preserving liquid. This suggestion, evidently not very popular in Roman times, is the precursor of our modern methods of treatment.

Today olives are still grown around the Mediterranean, where the winters are not severe but where there is enough cold weather to induce the trees to bloom the following spring. Spain is one of the leading producers of olives, having long ago received the knowledge and skill of olive cultivation from both the Romans and the Arabs. Many of the green olives consumed in the United States come from Spain. The black olives produced in this country come also, although a great deal more indirectly, from Spain. The Spanish introduced olive trees into their colonies in the New World. One of the colonies was California where the first olive trees were planted by Father Junipero Serra in the mission at San Diego in 1769. Progeny from these cuttings gave rise to one of the primary black olive varieties grown in the U.S. today—Mission.

All cultivated olives belong to the same species, *Olea europaea* L. There are hundreds of named horticultural varieties, some of which have been developed especially for oil extraction. The majority of table olives today come from four varieties. The Mission and Ascolano varieties are used for ripe olives. Green olives, both Californian and Spanish, are made from the Sevillano and Manzanillo varieties. These same two varieties sometimes go under the name "Queen" olives, a name applied to any large, green olive. The Mission and ripe Manzanillo varieties are used in the preparation of Greek-style olives while the Sevillanos alone are used in making Sicilian-style olives. Of these varieties, only Mission is used for oil as well as pickling.

The treatment of table olives is designed to remove the bitter flavor caused by the glucoside oleuropein and to preserve the color and texture of the fruit. With the exception of Greek and Sicilian style olives, all table olives are treated with an alkaline solution (sodium hydroxide) which destroys the bitter flavor. After soaking in several dilute sodium hydroxide baths the olives are washed to remove all trace of the lye.

In the production of ripe olives the 5 or 6 alkali treatments are interspersed with periods of exposure to air. The alkali bleaches the natural color of the olive but exposure to air permits the oxidation of certain compounds to a darker color and hence to a more

pleasing aspect to the consumer. The black ripe olives are then stored in brine where, depending upon the process used, they may or may not undergo fermentation. Ultimately they are canned in dilute brine and sterilized.

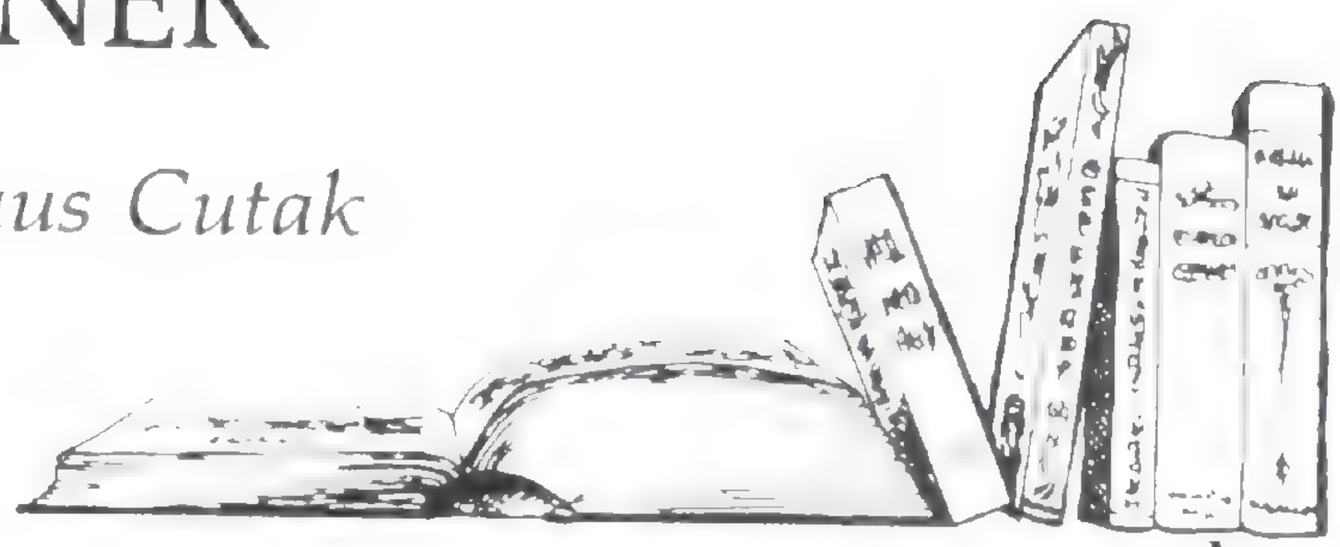
Green ripe olives are pickled immediately after two sodium hydroxide treatments and without the fermentation process. They are not allowed to come into contact with air, which would darken the color. The pickles are finished in the same manner as the black ripe olives.

Spanish style green olives are picked at full size but while they are still green or straw colored. A dilute lye solution is applied and then leached out, with no exposure of the fruit to air. The green olives are then stored for several months in heavy brine and undergo lactic fermentation until the desired acidity is reached. Sugar is often added in order to keep the fermentation going throughout the whole storage period. The high acidity of the liquid prevents bacterial spoilage of the olives. The finished olives are packed directly in fresh brine or may be submitted to pitting and stuffing before the final canning.

These three olives—ripe, green ripe, and green—are the result of improvements and refinements over ages of time in the selection and care of the trees and in more recent times of the chemistry and technology involved in preserving olives with the best color, the firmest flesh and the least loss during treatment and storage. However, two styles of olive still being prepared today hark back to the great period of experimentation with olive preparations. These are Greek and Sicilian style olives. Greek olives are prepared by alternate layering of very ripe olives and rock salt. The olives are allowed to stay in the salt until the bitterness is nearly gone and the olive flesh has become shriveled. They are then separated from the salt by screening, coated with olive oil, and packed. Sicilian-style olives would be familiar to Horace or Palladius. These are green olives, pickled directly in brine and flavored with garlic, fennel, and sweet peppers just as in the Roman recipes. Thus, most of today's table olives have come a long way from the first groves in Palestine 6000 years ago but they have not left all of their history behind. □

BOOK CORNER

A Review by Ladislaus Cutak



MAKING THINGS GROW

by Thalassa Cruso (Knopf)

MY FIRST INTRODUCTION to Thalassa Cruso was when I saw her on a Johnnie Carson late evening talk show. She butchered a philodendron right before my eyes and, at first, the thought ran through my mind that her act was some kind of a gag, but she was quite serious about the whole thing. Most home gardeners, as you know, are quite cautious and often handle house plants with kid gloves which is not necessarily the right thing to do. I must admit Thalassa Cruso has a unique television flare which demands that one make a critical evaluation of her horticultural knowledge.

This lady now has written a book, *Making Things Grow*, and strange to say, I found it pleasurable reading, concluding that she very definitely does know what she is talking about. In the various subchapters she often exposes some of the myths that are prevalent in home culture and though at times I do not agree with what she propounds, I realize that conditions for indoor gardening are extremely variable.

Thalassa Cruso, star of educational television's *Making Things Grow* and author of the book of the same name.

The reader will gain much valuable knowledge as to mastering the art of watering, clay pots versus plastic, how to make good potting soil, foreseeing various danger signals, striking cuttings under humid conditions, staging plants for effect, and utilizing lighting units to either supplement available natural light or using artificial lighting entirely in dimly lit locations. At the end of the book are several pages of recommended plants and their growing conditions. The book is amply illustrated with attractive ink and wash drawings by Grambs Miller. □

A FEW ANDERSON GEMS

EDGAR ANDERSON (1897-1969) wrote prolifically throughout his botanical career. His popular writing included little pieces such as the following, which are botanically correct, horticulturally interesting, and, above all, delightful to read.

GRANDMA GRIFFITH'S VIOLETS

Those who have spent springtime in England never cease to regret that our common American violets, though as beautiful a blue as the English *Viola odorata*, lack its lovely perfume. There are a few dwarf sorts of the English variety that are quite hardy. One of these makes a fine ground cover for a sunny spot as in our herb garden.

Grandma Griffith was a Quaker pioneer who brought her violets with her when she moved to McNabb, Illinois, not far from Peoria. In that rich prairie soil they were absolutely hardy, almost a weed.

The families of the little Quaker settlement at McNabb have them in their gardens, but know no other name for them than Grandma Griffith's Violets. They are charmingly fragrant but they never were designed for corsages; the flower stems are less than an inch long and gently curved. The blue is such a pale blue that they seem almost white. The fragrance is like that of ordinary English violets, but more delicate. After flowering they make a cover of green leaves not quite so heart-shaped as those of our American blue violets.

OUR HARDY CEDARS OF LEBANON

Our hardy cedars (we have two of them) did not come from Lebanon; true cedars of Lebanon are not winter hardy north of Arkansas. Our hardy ones came from Anatolia in the Anti-Tauras mountains of Turkey.

Professor Sargent of the Arnold Arboretum imported seeds of them collected according to his direction by a German botanist stationed in an area known to the Turks as Messina, but referred to in the English bible as Tarsus, where St. Paul was born. They are smaller, hardier, slower growing trees and have been referred to as *Cedrus libani* var. *Sargenti*. All of the true cedars have weeping forms, even the gray blue Atlas cedars from the coastal hills of North Africa.

Our two Sargent cedars have given us both a spire-shaped tree in front of the Experimental Greenhouse and a weeping variety along the pathway from Tower Grove House to the Herb Garden. When this one was younger it looked almost deformed, as though its top had been blown out by the wind. Now that it has many gracefully pendant branches it is charming in its own strange way.

THE SCOTCH ELM AT TOWER GROVE HOUSE

The Garden has one magnificent old Scotch elm. The west window of Henry Shaw's bedroom looks out at its gnarled trunk, crooked branches, and shiny green leaves.

Botanists have disagreed as to the correct scientific name for a Scotch elm. The dispute continues although L. H. Bailey put it in *Ulmus glabra*. Our specimen agrees with his description of the elaborate and handsome way its leaves are indented around their edges.

Modern experts are reasonably certain that it belongs to a complex set of hybrids. However, when Dr. H. M. Heybrook, the Dutch expert on elms and elm breeding, visited the Garden in the early spring of 1969 he said this particular tree was similar to well grown Scotch elms he had studied in Europe. A smaller specimen down near the corner of the water lily pool was perhaps a related hybrid.

When I first saw the Tower Grove House specimen in the autumn of 1922, it was already a large tree with dramatically zigzagging branches. It seems quite possible that this elm was planted in Henry Shaw's time. □

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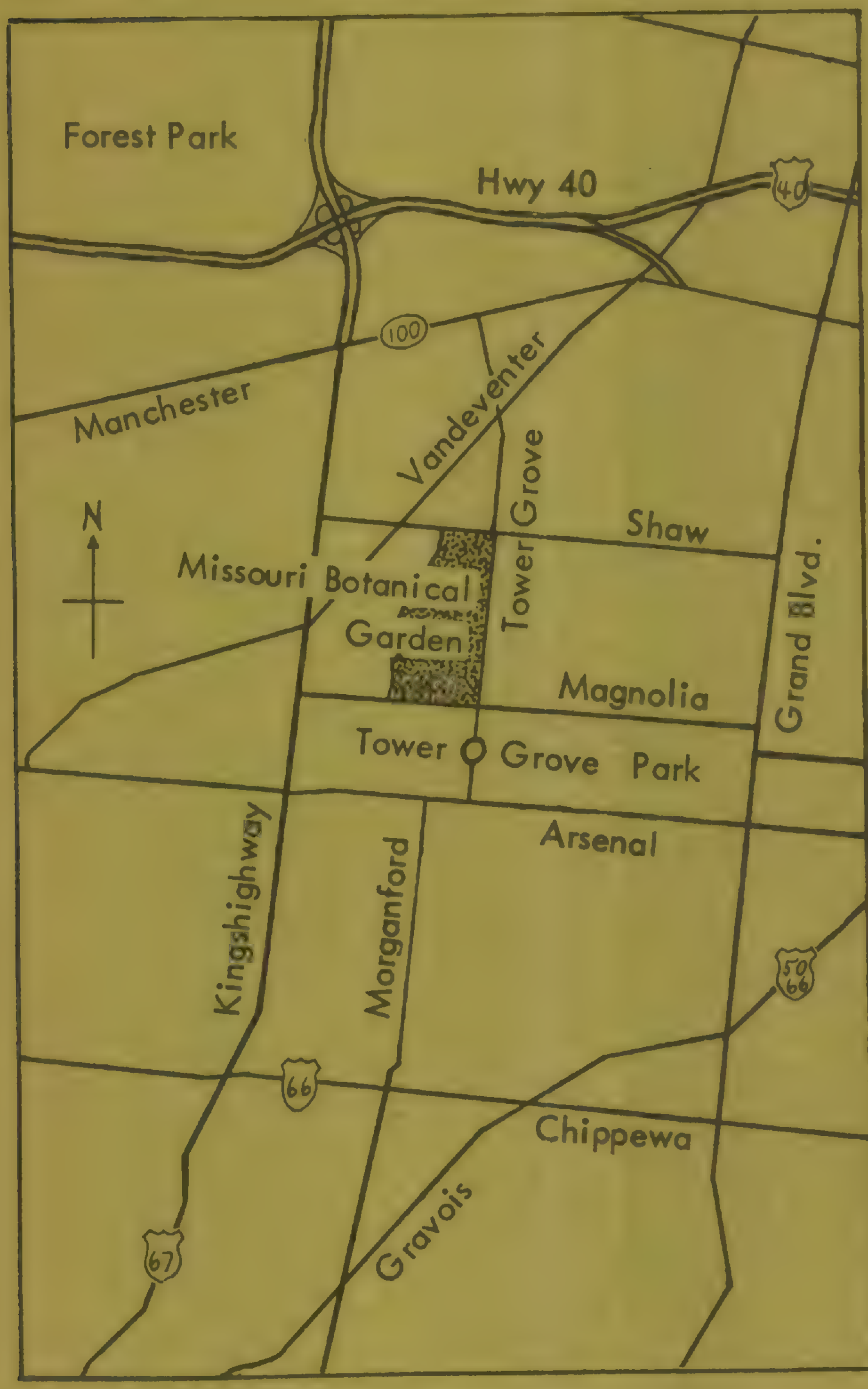

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MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVIII NUMBER 4

JULY-AUGUST 1970

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From the Director

SCIENCE IS THE wellspring of technology and the nutrient of invention from which modern civilization emerges. The citizens of our society live long and well, have fine homes, good transportation, fine communications, good food, and one of the highest standards of living ever achieved by man. The good life we live is the result of the genius of invention and the production achievement of industry. Naturally we, as a society, do not wish to give up our good life nor do we want to see it degenerate because of the insults we deliver to the life support system—the air, the water, the soil, the plants and animals of the world.

Never before in our history were we so critically dependent upon science as we are today to help us solve the problems of population explosion, pollution, climate change, food supply, and ecosystem management. Ironically, not at any time during the last 25 years has the dollar support for scientific research, training, education, and application diminished as rapidly as it has during the last two years because of the national spending on war and defense. Science in America today is in deep trouble because of reduced financial support. Our national priorities and sense of values are badly confused, our goals are clouded, and our ability to correct the problems of society are seriously weakened.

I have been asked to assume two national positions of very high responsibility. I have agreed to do so because of a feeling of obligation, a sense of duty, and a conviction that science is needed by society far more than ever before in our history. The time I shall spend on the duties associated with these positions is time away from the Garden. Our fine staff members have agreed to help in every way they can to make this national contribution possible. The Missouri Botanical Garden has always assumed a position of national and international leadership in science. Even during its earliest years the Director of the Garden and members of the staff were called upon for national responsibilities.

First, my nomination to the National Science Board by President Richard Nixon was confirmed by the U.S. Senate on 19 May 1970.

This is the highest policy making body in civilian science. The National Science Board is advisory to the President and to the Director of the National Science Foundation. The appointment is to a six year term. There are 24 members on the National Science Board.

Second, Dr. Philip Handler, President of the National Academy of Sciences and Dr. Eric A. Walker, President of the National Academy of Engineering asked me to be Chairman of the Environmental Studies Board of the two academies. Starting 1 September 1970 I shall assume the Chairmanship on a one quarter time basis and the academies will pay to the Garden one quarter of my salary. The National Academies of Science and Engineering are the highest honorary societies in American science. The Environmental Studies Board was established 3 years ago in order to make available the best possible advice to the Federal Government concerning environmental problems. The Environmental Studies Board issued two important reports within the last few months. One was entitled Institutions for the Effective Management of the Environment and the other was Environmental Problems in South Florida. The Board is involved currently with a study of the expansion of Kennedy Airport in New York and the improvement of the ecology of Jamaica Bay as an example for large airports throughout America. They are also undertaking a study of nuclear power station needs of the U.S. and are becoming involved in the assessment of the ecology of Alaska. The Environmental Studies Board establishes special study groups to make in depth studies of the various problems with which they are concerned. The Environmental Studies Board will work very closely with the new Environmental Quality Council of the White House.

The Missouri Botanical Garden is an unusual resource for information concerning plants, horticulture, scientific botany, ecology, and environmental issues. The Garden staff is here because the institution does have a large herbarium of preserved plants, an unusual botanical library, very fine grounds and displays, and a direct academic affiliation with Washington University through our professional appointments. It is no accident that we are called upon for national leadership. This was a part of the design of Henry Shaw when he established the institution. We are proud and pleased to continue this tradition.

David M. Gates

MISSOURI BOTANICAL GARDEN BULLETIN

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THE SINGLE GARDEN BLACK POPPY (COVER)

Carla Lange

THE COVER ILLUSTRATION for this issue of the Bulletin is from a woodcut of the Single Garden Black Poppy in John Parkinson's *Theatrum Botanicum*, published in London in 1640. Parkinson mentions as the virtues of this plant: "The Garden Poppy heads with seedes made into a Syrupe, is both frequently used in our dayes, and to very good effect to procure rest and sleepe in the sicke and weake, and to stay catarrhes. The black seed boyled in wine and drunke, is said also to stay the fluxe of the belly; it is also put in the hollow teeth to ease paines, but Galen and divers others in the former as well as in our times, have forbidden such medicines, as too dangerous for the eyes, it is not to be taken, but with good correction and great caution, yet divers have found that applyed to the gout, it hath given much ease of paine."

The common black variety of poppy has stalks about three feet high, smooth and dividing into several branches; the leaves are large, smooth, deeply cut or jagged on their edges, the petals purple with dark bottoms; succeeded by oval, smooth capsules filled with black seeds. The seeds will fall out if the head of the flower is turned downwards. Jules Verne in his book *The Mysterious Land* states that the capsule of the poppy's head contains 3,200 seeds!

The poppy is important as a curing and oil rendering plant. The discovery that opium may be gained from the seeds of this plant was

probably made by the Greeks and by the beginning of the Christian era, the knowledge of opium may be said to have become universal. Pliny draws special attention to the medicinal value of the opium. From Dioscorides' remarks it may be inferred that in his time the art of extracting the drug constituted an important industry in Asia Minor. Its sleep bringing powers were already known in Homer's time. Since about the fourth century, the God of Sleep is shown with the stem of the poppy in his hand. If the Greeks discovered the opium, the Arabs were certainly responsible of carrying the knowledge of this drug to the Eastern countries. They made it known in Persia, India, and China. In China, the opium became popular as a drug around 1650. In 1728, the smoking of opium was banned and the import of opium into China was outlawed in 1796. However, England subsequently fought her so-called opium wars (1843, 1856, and 1869) against China which ended the import ban of opium into China. In Germany, the opium was introduced by Paracelsus who called it Laudanum. The poppy was also known in England and Curtis says in his *Botanical Magazine* of 1788 "that though native of the East, it bears the severity of our climate without injury, flowers in May, and as its blossoms are extremely shewy, it gives great brilliance to the flower garden or plantation; prefers a dry soil."

In North America and many European countries, the cultivation of papaver (poppy) has been given up since it proved to be unprofitable because of the price of land and the high wages. In many areas, the poppy seeds are used as a spice in food and as a topping for breads, cakes and rolls. The poppy oil is gained from the black seeds by a pressing process and can be used as a substitute for olive oil; it has no intoxicating properties. By a second pressing process, an inferior oil is gained which is used in the manufacture of soap, paint, varnish, etc. The cake left after the extraction of the oil is used for feeding cattle. □

GARDENING IN ST. LOUIS

July and August

ST. LOUIS SUMMERS are often not as bad as some say. By planning to do heavier outside work in the cool of the morning, one can often manage to avoid the discomfort of the afternoon heat. A leisurely walk around the garden at dusk will show what should be done the next day. Check the soil for moisture, the weed situation, the flowers that can be picked, and, most of all, enjoy the fruits of all your gardening labor.

Heavy organic mulching really brings dividends in hot, dry weather, but be sure to feel the soil under the mulch to see if water is needed. Soak lawns, shrubs, trees, and flower beds every few days as needed so that the soil is moist to a depth of six inches.

Give old shrubs a new lease on life by following a careful pruning program of removing a third of the oldest and non-productive stems to the ground each year. Prune shade trees at this time also, sealing larger wounds with an unobtrusive paint. Always keep in mind the desired shape of the plant as you work on it. It's too easy to get carried away and ruin a lovely specimen.

A healthy bluegrass lawn is the pride and joy of its owner. Bluegrass is basically a cool climate plant, quite unenthusiastic about heat, so do not cut it shorter than three inches nor should you mow more than half of the leaf length at one time. This will also help discourage the shallow-rooted, sun-loving crab grass.

Geraniums will thrive on a shaded patio only if they are given some full sun each day. Easy-to-move pots of these handsome plants often provide the needed touch of color to make a so-so patio truly beautiful.

Work with a reliable nurseryman to develop a program of spraying and fertilizing when it is needed. Companion planting to reduce pests and conscientious mulching are two gardening practices that will make your life easier and your garden more successful.

THE EUROPEAN TURKEY OAK

Paul A. Kohl

IN THE SPRING of 1897 "ordinances were introduced and passed authorizing the opening and widening of Flora Avenue from Grand to Tower Grove Avenue, a distance of 4,438 feet, to a width of one hundred and forty feet, to be improved with driveways on either side of a park place in the center. This street is to be fully improved with granitoid curb, gutters and sidewalk, and telford pavement, with sewers, gas and water service, trees, shrubbery, etc. The work is now under way, being done by private contract, and when completed in the spring this will be the finest residence street in the city, and practically the Grand Avenue entrance to the Garden."

The above information is taken from the 1897 Director's Report to the Trustees of the Missouri Botanical Garden. The 1898 Director's report indicated that the improvement of Flora Avenue had been completed and that a magnificent entrance, costing $9,500 had been erected on Grand Avenue at the entrance to Flora Boulevard. Although the entrance to this day bears the inscription "Flora Boulevard" the street is now named Flora Place. The change in terminology was made at the time when boulevard stop signs were erected and Flora Boulevard was not considered a boulevard.

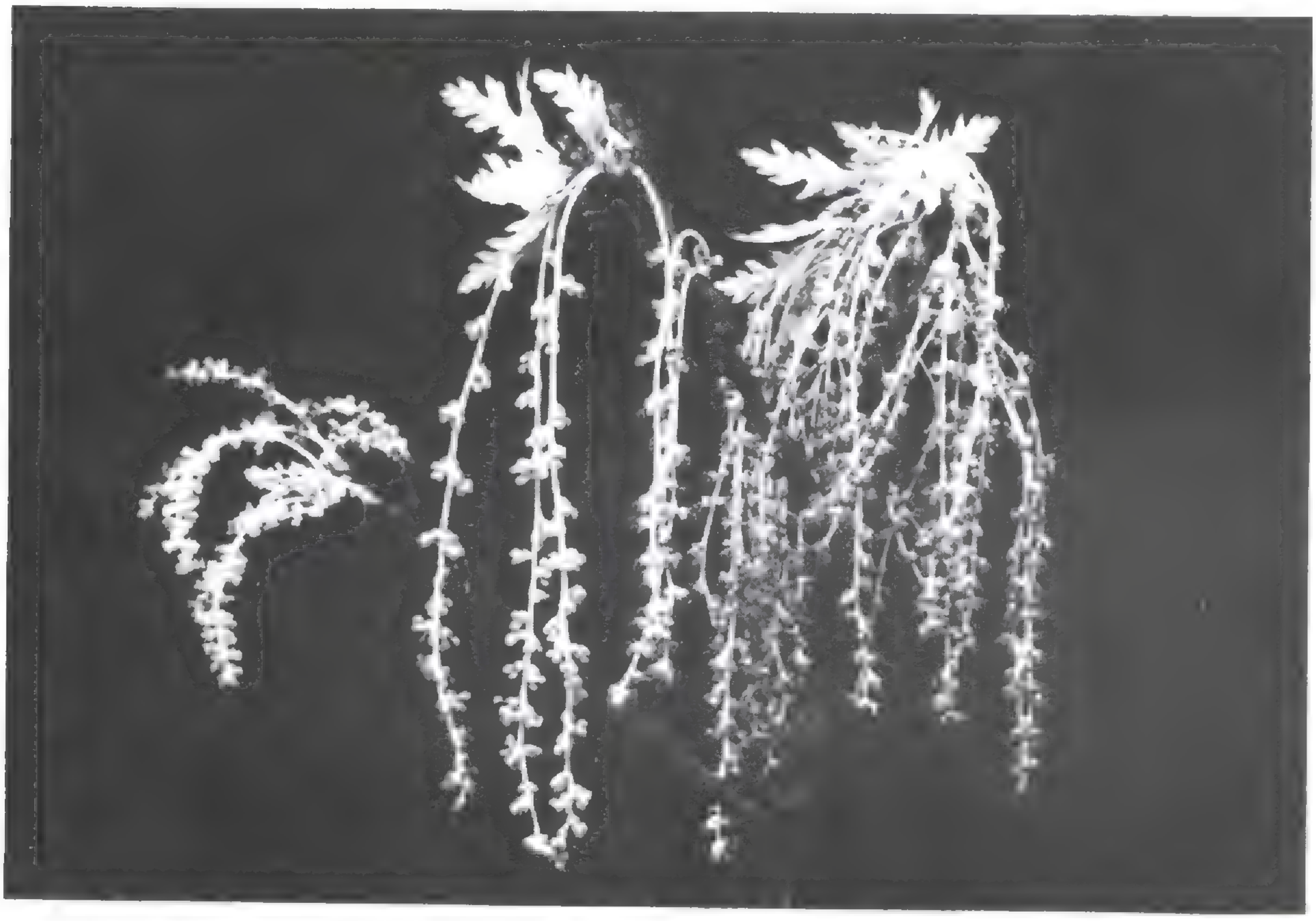
L. H. Bailey's *Manual of Cultivated Plants* states that there are over 300 species of oaks in the world and lists twenty-one of them. Only five European species are described in the manual and one of these is the Turkey oak, *Quercus cerris*. No records are available to indicate who the contractor was when Flora Boulevard was im-

Paul A. Kohl

Mature Turkey oak at Lawrence and Flora Place.

proved or where he obtained the trees and shrubs for planting the central park area. The question is, how did this Turkey oak, a European species, come to be planted on this boulevard? There are fifteen of these oaks on Flora Place and all of them appear to be of the same age. The best, uncrowded specimen, the one pictured, is just west of Lawrence Avenue in the forty-hundred block of Flora Place.

Interest in these Turkey oaks was stimulated some years ago when members of the Flora Place Garden Club began labeling the trees in the parkway and realized that here was an interesting oak not found growing in any other part of the city. This oak has several distinct characteristics like the deeply lobed leaves, the furrowed bark, and the mossy cups with recurved scales. Bailey's *Manual* states that "*Cerris* is probably from the Latin for fringe, referring to the mossy cup." The leaves appear in early May, become deep green and remain green in October when other tree leaves turn color or fall from the trees. Only in late November do the leaves of these oaks gradually turn brown and drop from the trees. The tree in the



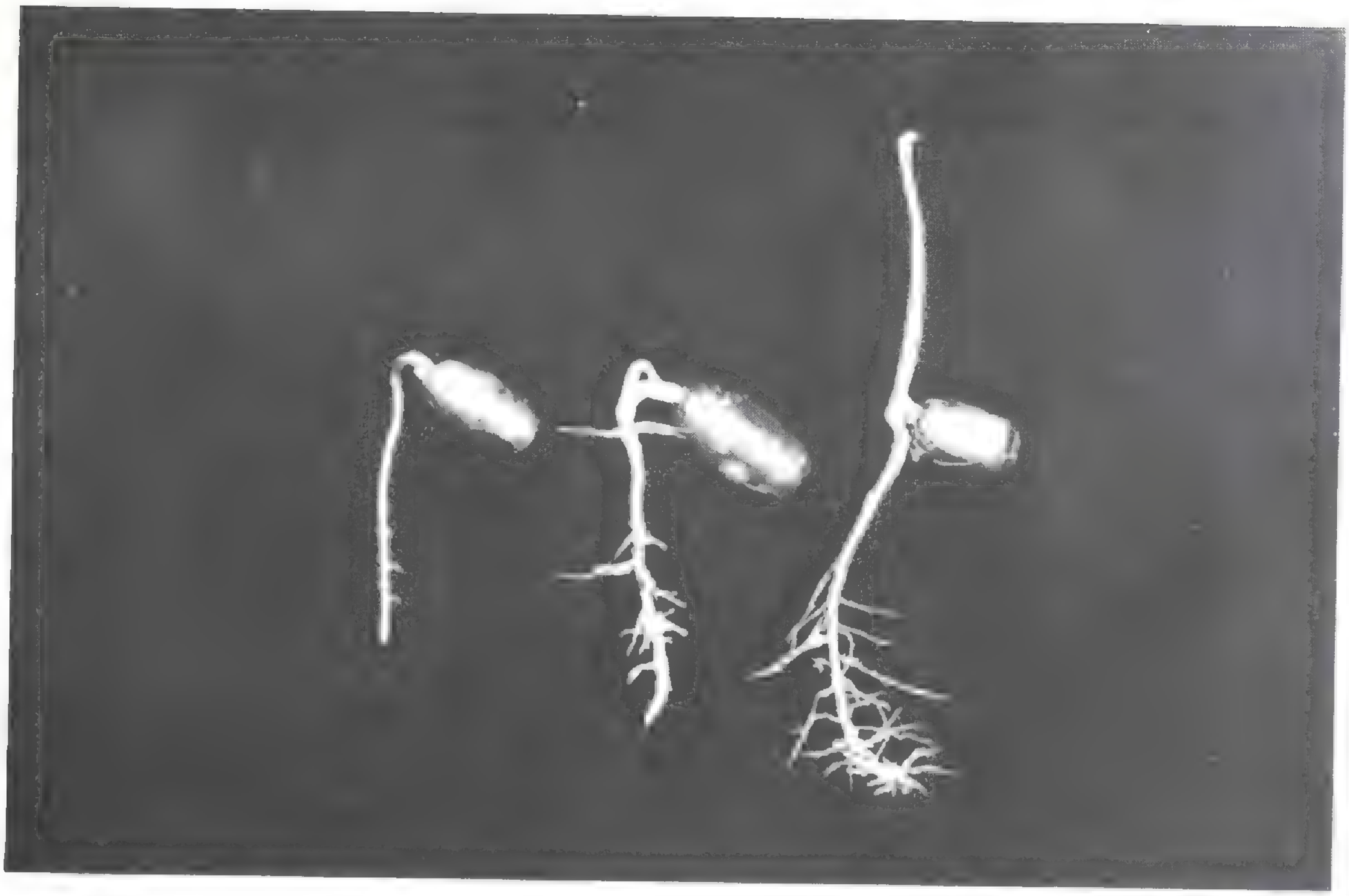
Paul A. Kohl

Staminate catkins of Turkey oak in early May.

illustration was photographed on November 25 which shows the contrast in leaf retention with a bald cypress in the foreground and the bare sycamores to the right of the tree trunk in the background. The acorns are oblong, an inch or more long, and ripen the second year. If sound acorns are gathered and stored in damp sand, peat, sphagnum, or similar material they will eventually sprout as shown in the illustration. In a cool greenhouse this group of seeds began germinating three months after being collected. Squirrels are very busy when the acorns are ripe, burying them in many places for future use. This is nature's way of distributing the seeds, the squirrels being the harvesters and planters, for many of the buried acorns germinate and grow into trees. The tap roots grow so fast and are so strong that it is difficult to uproot seedling oaks in the second year. Under the assumption that the Flora Place oak trees were planted in 1898 they are now seventy-one years old, have done remarkably well, and show no signs of deterioration. Had their good qualities been recognized earlier they would have made good street trees

Paul A. Kohl

Turkey oak acorns.



Paul A. Kohl

Three stages of sprouting Turkey oak acorns.

which would now be in their prime while the elms, sycamores, and soft maples that were planted at the same time are dying out.

Some years ago I chanced to come upon an article in the January, 1952 *Journal of the Royal Horticultural Society* in England entitled "A Quarter of a Century of Highway Planting." I was interested in seeing a picture in this issue of Turkey oaks and thorns on the Kingston By-pass planted in 1929 on London clay. In reference to this oak the article states "Turkey Oak *(Quercus cerris)* has responded well on the whole, and a shapely row of these, planted 20 years ago on the very poor clay soil of the Kingston By-pass are 25-30 feet high today."

For general planting the pin oak is probably the most popular of the oaks and it has the reputation of being a fast-growing tree. From observation it appears that this Turkey oak grows just as rapidly as the pin oak. It is frustrating to describe the good qualities of a plant, such as the Turkey oak, and then end the article by not suggesting a source where it might be secured. It is just possible that some of the eastern nurseries might grow it but the alternative is to grow your own trees if you are fortunate enough to find some acorns beneath the trees. □

THE CLIMATRON

Missouri Botanical Garden's Space Age Greenhouse

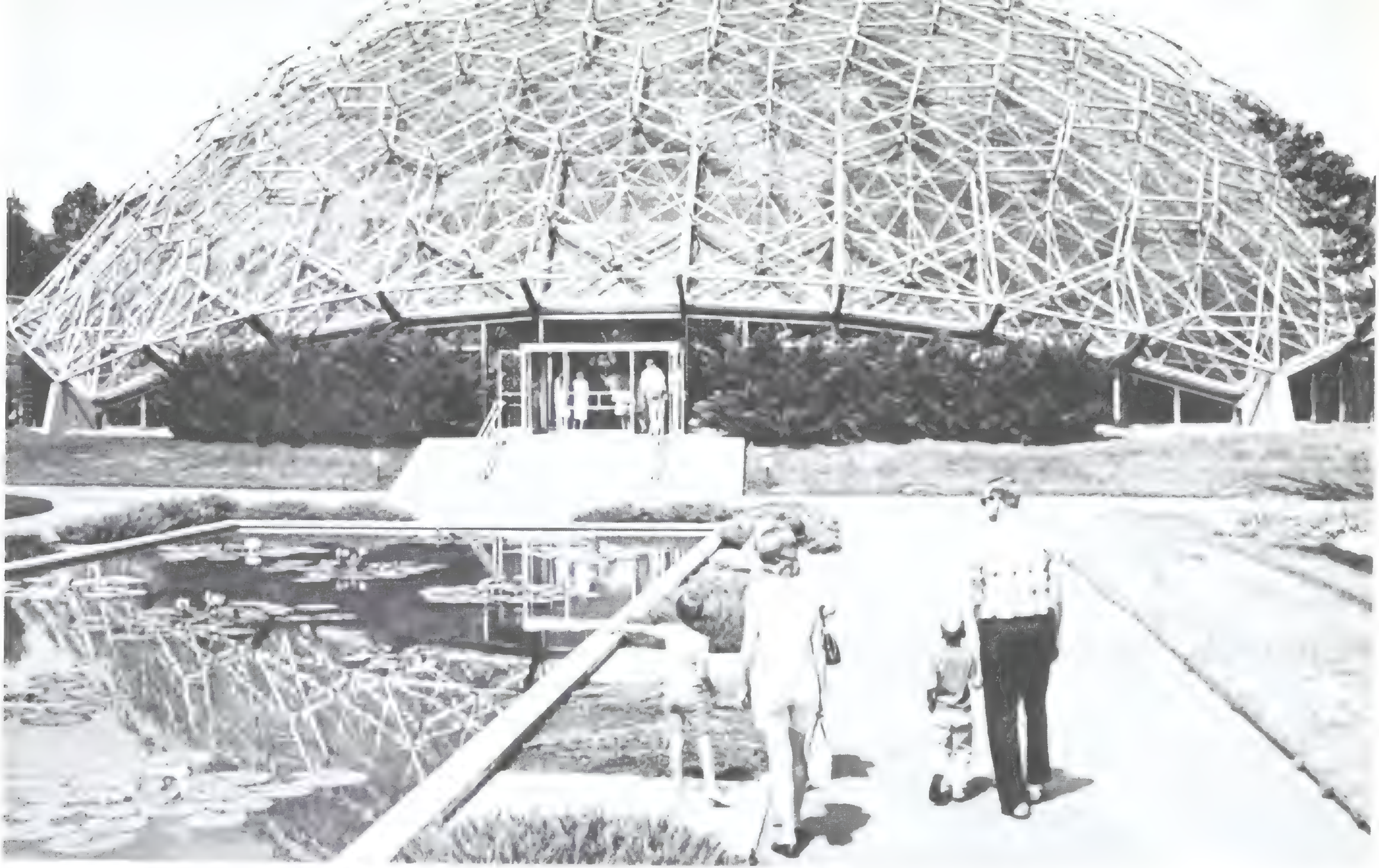
Robert Dingwall and Barbara Lawton

THE CLIMATRON, one of the world's most advanced display-research greenhouses, was opened to the public on October 1, 1960. It contains a large portion of the Missouri Botanical Garden's tropical and semi-tropical plant collections, in settings which closely approximate the native environments of the various plants.

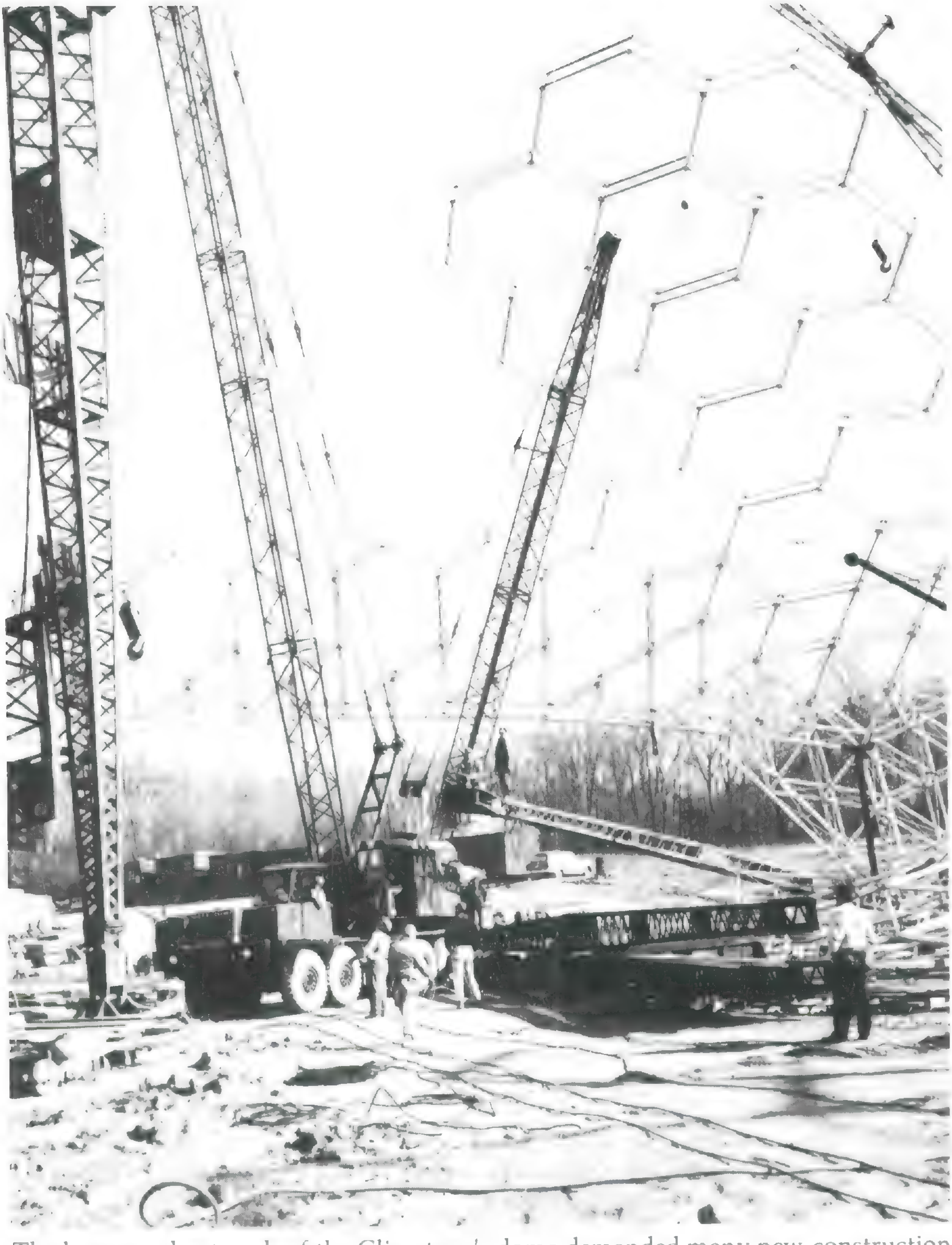
This unusual greenhouse was started in 1959, replacing three old houses which had reached an impossible state of age and decay. Dr. Frits W. Went, then Director of the Garden, developed the plans for the Climatron in consultation with St. Louis architects Murphy and Mackey. The structure follows principles established by R. Buckminster Fuller, inventor of the Geodesic Dome.

The Climatron, a term coined to emphasize the climate-control facilities of the structure, is 70 feet high and 175 feet in diameter. It contains a volume of 1,300,000 cubic feet and a ground surface of 23,000 square feet (over ½ acre). The dome shape is very economical for a building unsupported in the center; it has the smallest surface possible for its volume, and offers very interesting possibilities for enclosure and growing space. Triangular plexiglas (acrylic plastic) panels mounted with neoprene gaskets in a aluminum framework give a high degree of light transmission, allowing, even in winter, a fair amount of photo-synthesis.

The planning had to include air-conditioning to prevent excessively high temperatures inside. Since the Climatron houses tropical plants it was sufficient to plan on air-conditioning by evaporation, which is the simplest and most economical way.



The Climatron is always popular with tourists as well as St. Louisans.



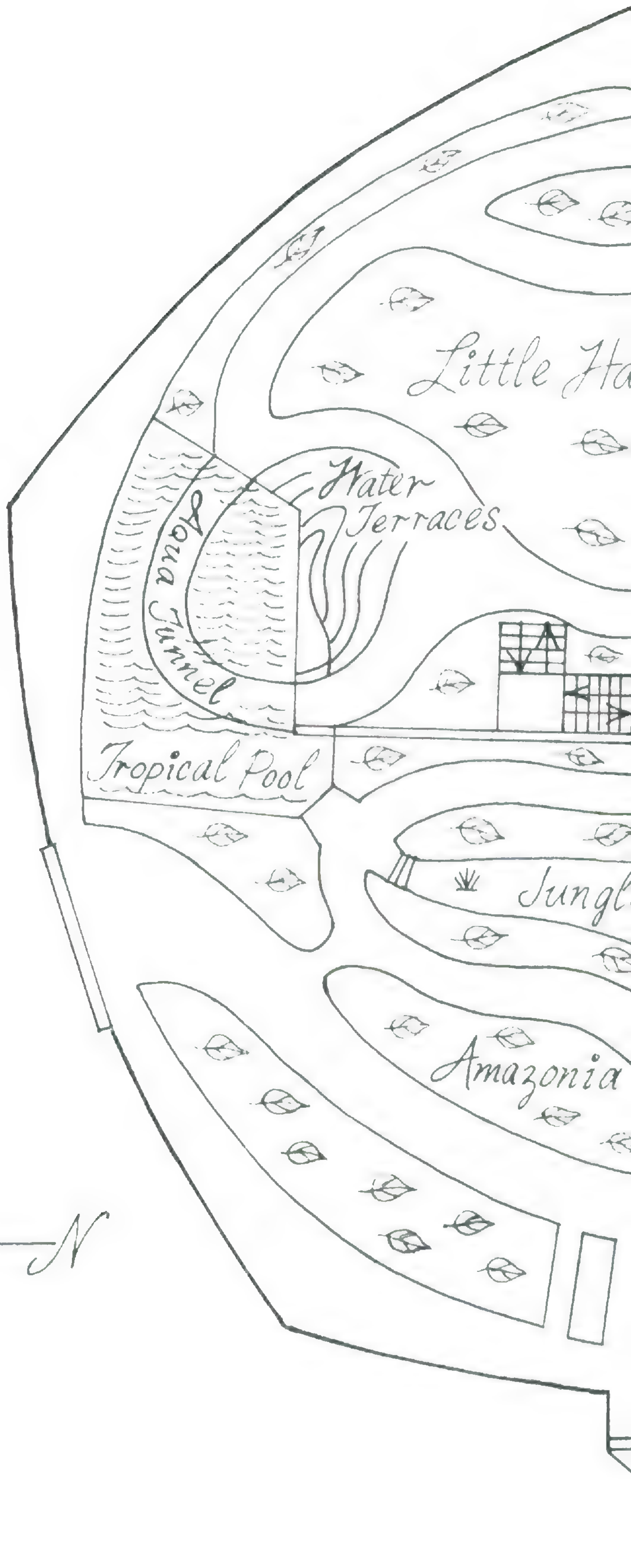
The hexagonal network of the Climatron's dome demanded many new construction techniques.

The triangular plexiglas panels of the Climatron's dome are mounted with neoprene gaskets in an aluminum framework.

The size of the Climatron, larger than any greenhouse previously air-conditioned, posed several new problems. It was decided that, rather than trying to maintain an even temperature, a deliberate temperature gradient would be produced and maintained. During the day, air, cooled or heated to the desired temperature through water sprays, enters the greenhouse at the west end; exhaust fans are located around the eastern perimeter building. Necessary night heating is accomplished by an entirely separate air circulation system, producing a temperature gradient from south to north.

The structural and operational details of the Climatron are unique, and so is its planting pattern. Instead of growing specimen plants, areas have been planted to represent different ecosystems, such as an Amazonian jungle and Hawaii.

Continual pruning, planting, and removal of less desirable plants goes on, with the overall aim of allowing plants to assume their natural shape in a natural setting. Larger trees reach to the very top of the Climatron and the winding paths are so separated by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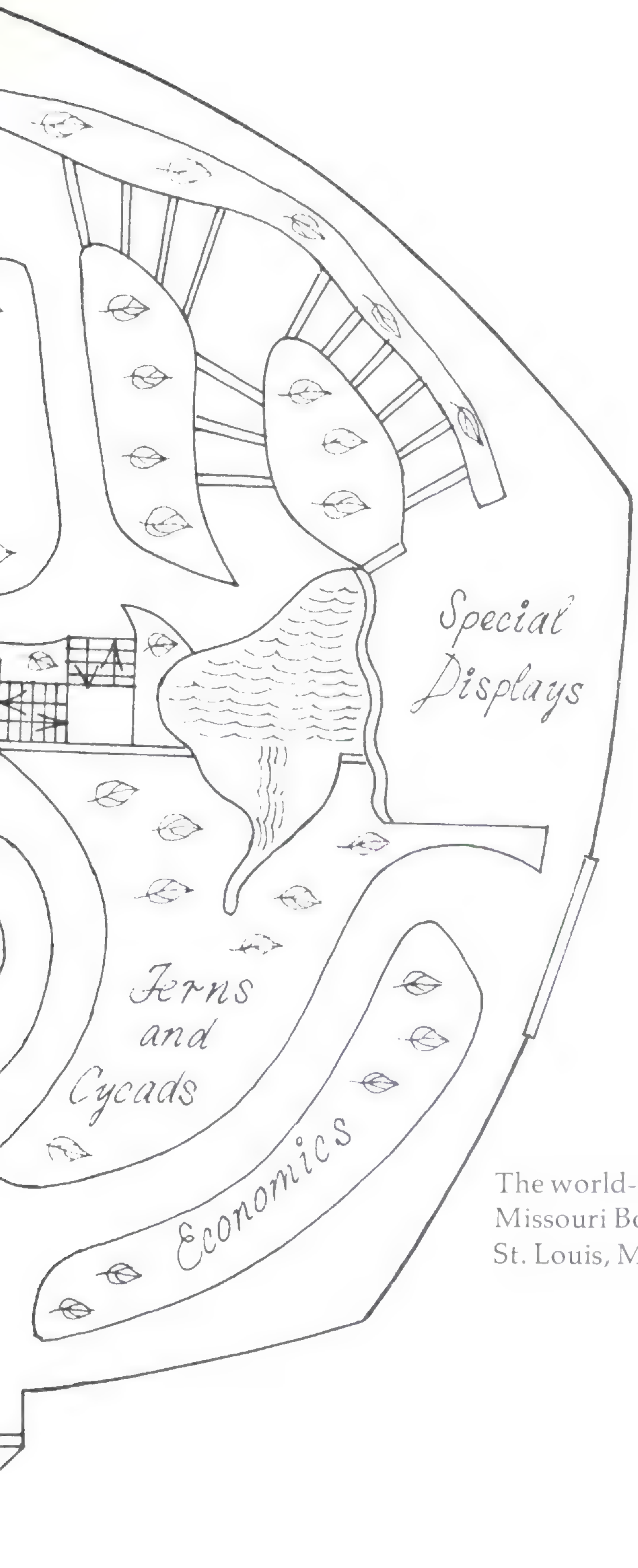


The world-renowned Climatron,
Missouri Botanical Garden,
St. Louis, Missouri

luxuriant growth that a visitor really feels that he is in a jungle. Hundreds of thousands of school children have discovered and explored this strange land of the tropics without leaving the temperate zone of St. Louis.

The Climatron, ten years old in 1970, has taken its place as a breathtaking landmark of not just the St. Louis area but of the whole country. It has been featured in countless stories and publications throughout the world, is often glimpsed as the romantic setting of high fashion ads, and is a favorite spot for tourists and St. Louisans alike.

As to the special aesthetic appeal of the Climatron, the late Dr. Edgar Anderson expressed one aspect of it very well when he said, "It frequently has a special magic shortly before and after sunset. It is directly west of the Main Gate and the tropical lily pools, so that the sun sets behind it. Since the far side of the structure is twelve feet lower than the nearer side, the setting sun can shine into it from the rear, though concealed from the observer, filling the dome with sunset light and giving an opalescent glow to its surface. On the best of such evenings the sunset in the sky and the sunset in the Climatron go through a long series of changes which are variously mirrored in the pools."

THE PLANTS OF THE CLIMATRON

Representatives of many interesting and economically useful plant groups are in the Climatron. A general description of some of these is included here. There are also many descriptive labels on individual plants that will make a walk through the Climatron informative as well as enjoyable.

FERNS

Ferns of the tropics and subtropics are the greenhouse ferns of temperate zones and include a number of kinds suitable for use as

house plants. To cultivate them successfully it is desirable to imitate the environment in which they grow naturally, and to provide moist, humid, sunless but light, conditions essential to their well being. Night temperatures should be around 55° with 12°-15° increase in day temperatures.

Ferns require good drainage and a potting mixture that is light, fibrous, spongy and capable of retaining moisture without becoming soggy or solid. Good materials are a combination of good clean loam, peat moss, leaf mold, coarse sand, and granulated charcoal.

True ferns reproduce not by forming seeds but by spores which are formed by the millions in small spore sacs on the underside of their leaves or fronds, as they are usually called.

Some of the ferns found here are the large tree ferns, *Alsophila* and *Cibotium*, and many other fern groups such as the *Asplenium* sp., *Cyrtomium*, *Nephrolepis*, *Blechnum*, *Pteris*, and *Adiantum*.

CYCADS

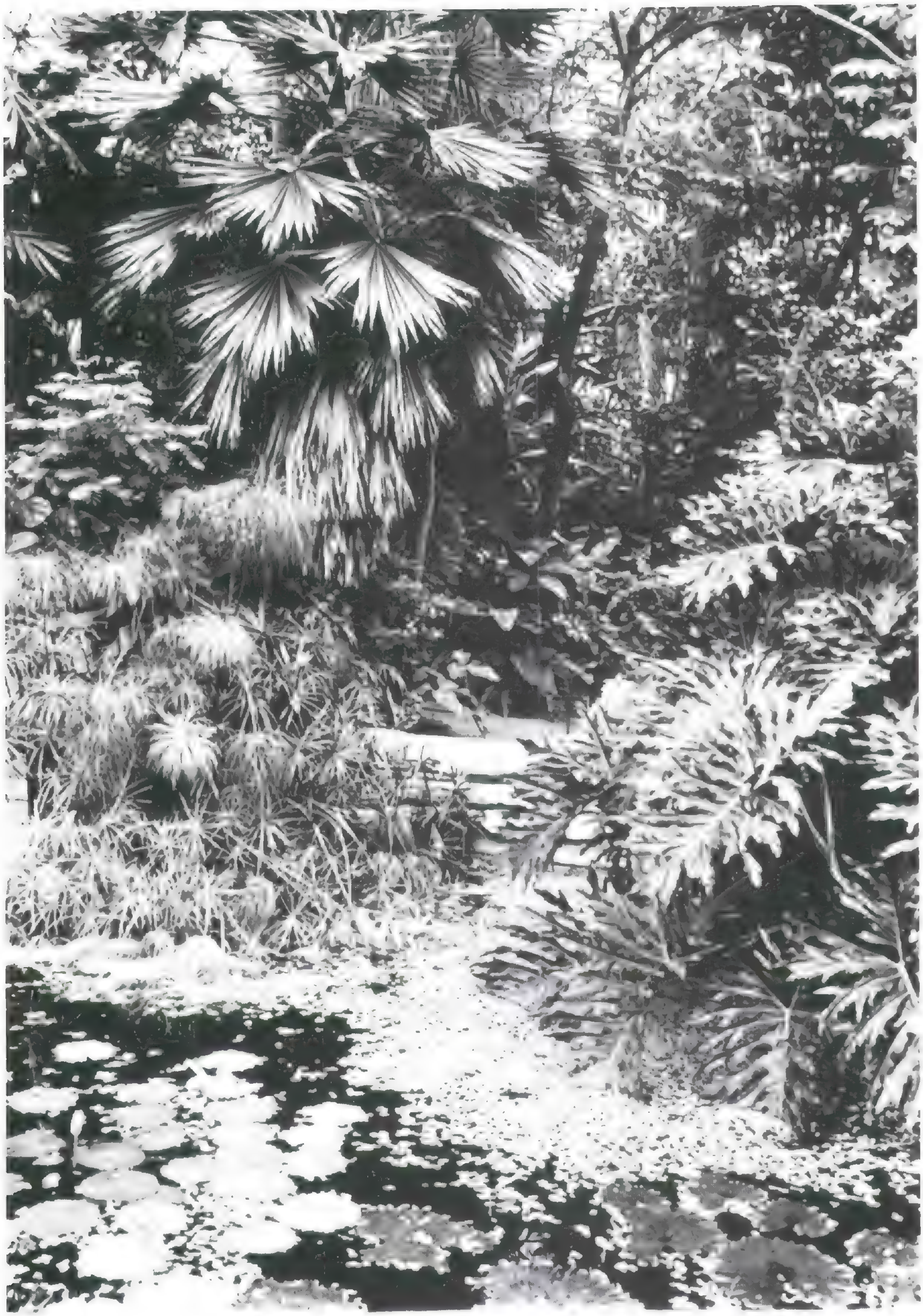
The cycads *(Cycaduceae)* or Sago palm family is geologically very ancient, has only nine existing genera and about seventy-five species of woody, fern-like or palm-like plants that once nearly covered the earth. They are, however, quite unlike ferns in bearing cones and seeds. Young plants do not have trunks but older plants have trunks of considerable height.

Genera represented are *Cycas*, *Zamia*, *Macrozamia*, and *Dioon*.

In 1908 through Professor Trelease, Director of the Garden, a plant of Zamia *tonkin-chinensis* was obtained. At that time only four plants were known to exist. This rare plant can be seen in the Climatron.

PALMS

The palm family are the most distinctive and noble foliage plants of the tropics. They range from stemless plants of pot culture to the magnificent royal palm, *Roystonea*, which in many tropical cities, makes imposing avenues of feathery foliage. Their economic importance is great, notably the coconut (Cocos), the date *(Phoenix)*, and African oil *(Claeis)*. Many other palms are of wide use in the arts and industries for fiber, food, drugs, resins, and wood and are also cut for ornament. Among these are species of *Arenza*, *Rutea*, *Caryota*, and *Raphia*.



Claude Johnston

Looking across the lake area toward the tropical swamp in the Climatron. The lake has an aquatunnel which gives visitors an underwater view of plants and fish.

The palm family is usually, but not technically, divided into two groups by the leaf shapes—the feather palms with pinnate leaves and the fan palms with palmate leaves. Fan palms not already mentioned are *Chamaerops, Coccothinax, Erythea, Livistona, Thrinax,* and *Washingtonea*. The other feather palms outstanding are the *Howea* or *Kentea,* and *Phoenix*.

The rattan palm *(Calamus),* found below the waterfall area, is scarcely cultivated in America and is really a climbing vine and of interest the way it is found growing here.

ECONOMIC PLANTS

Many plants of economic value from various parts of the world are found here. The coffee tree *(Coffea arabica)* bears a two seeded bean which is red when ripe. This is grown extensively in the American tropics and subtropics. The papaya *(Carica papaya)* bears very healthful fruits containing a pepsin-like enzyme which aids in digestion. The blimbi *(Averrhoa carambola)* bears bright yellow fruit which has an acid tang. This tree grows just inside the main entrance and produces pink to purple flowers which are formed at three times during the year—early spring, midsummer, and fall. The fruit is high in Vitamin C. Other fruits of interest are the citrus family to which belong the oranges, lemon, grapefruit and limes. There are figs *(Ficus carica),* the pineapple *(Ananas comosus),* often grown as a houseplant, and the banana *(Musa paradisiaca)* of which the cultivated varieties do not bear seeds. The loquat *(Eriobotrya japonica),* a relative of the apple, flowers and fruits usually twice a year. Rice is found growing in the water terraces below the main pool.

Another plant of interest is the bird of paradise *(Stelitzia),* a close relative of the banana. The flowerbuds are enclosed in a beak-like bract from which they emerge one at a time. The ginger family is represented by several genera and species mostly of the Old World and used for ornament as well as for the source of ginger.

Of special interest are the orchids displayed which include the many hybrid cattleyas, some of which were developed in the Garden. Some of these are fragrant while many are odorless. At the top of the waterfall are found many of the lady slipper orchids which are dark in color with greens and browns predominating. Many other species are displayed from time to time, and are of interest due to the size and variation of color. □

SPECIES ROSES IN THE UNITED STATES

Their Relationship To Modern Roses

Walter H. Lewis

THERE IS VERY LITTLE direct relation between our native and our modern roses. Why should this be and what, if anything, might we do about it?

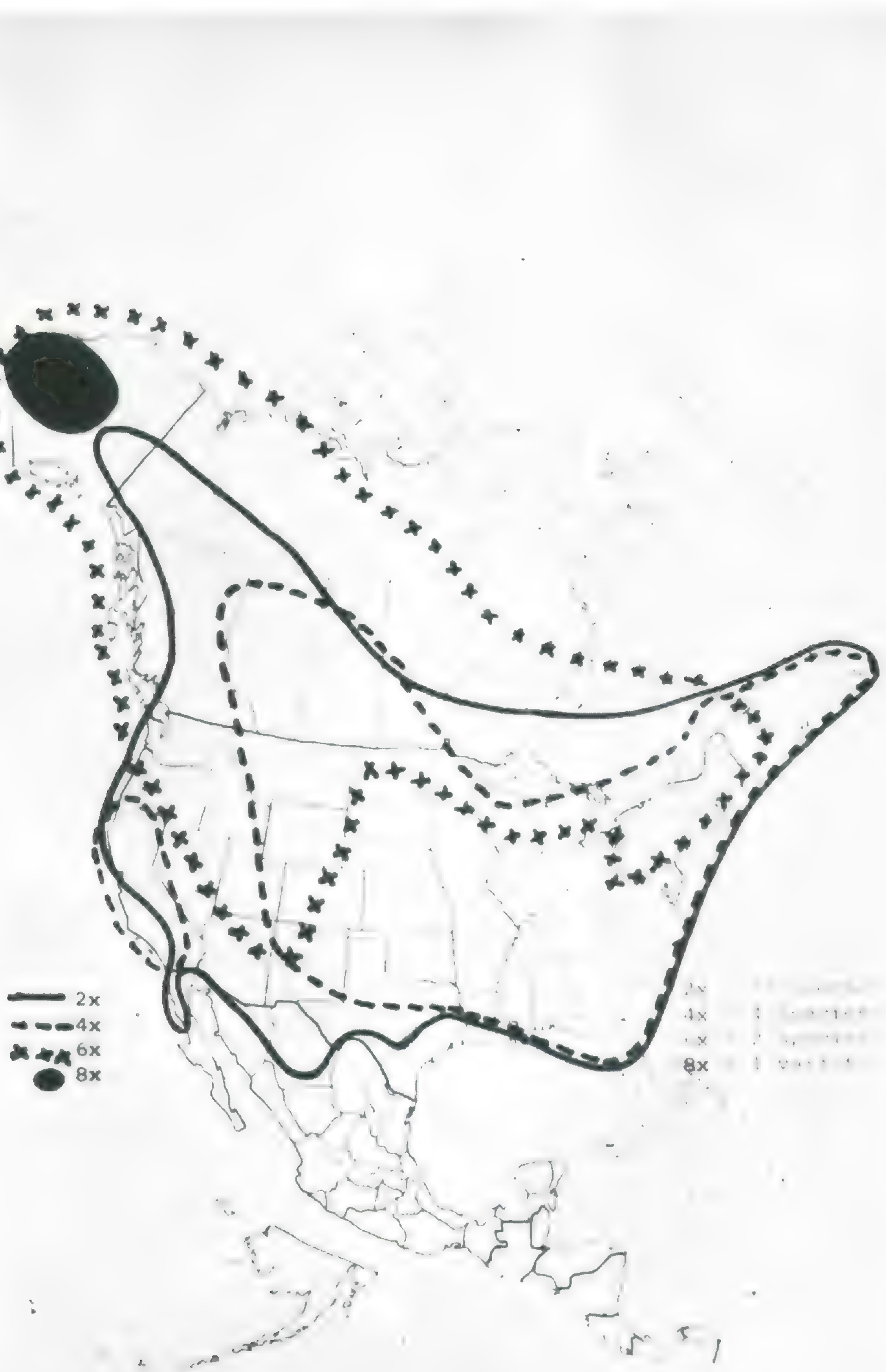
Certainly the first reason for the lack of involvement of native American species in horticultural roses is historic and perhaps even cultural. European horticulturists had their own stocks and, by the end of the 18th century, those of *Rosa chinensis* and *R. gigantea* from China. At that time only four native American species had been described and all were only vaguely known to the taxonomic world. None could compete with the much hybridized and selected stocks from Eurasia. Add to this the appeal of importing from the sophisticated East rather than from the wilds of Indian-infested colonial America, and we can understand why these Old World roses were routinely used in plant breeding by the Victorian era. Surely the Queen of Flowers, I could imagine hearing our predecessors say, deserves more than just a minor input from the backwaters of the New World!

So our involvement has been minor indeed in the evolution of modern roses: no American stock is found in the gallicas, damasks, musks, cabbages, mosses, and dog roses, all of which originated from European species; the noisettes, bourbons, and teas which originated from Oriental-European crosses as did our whole range of hybrid classes such as the hybrid chinas, hybrid perpetuals, and hybrid teas. Even our dwarf and hybrid polyanthas and hybrid musks are derived from these old stocks after direct crosses with native Oriental or European species.

This flower of *Rosa virginiana* has exquisite fragrance, transplants easily, and is extremely fertile. This rose is worthy of incorporation into modern roses.

What of our native species? Are they too difficult to find, too difficult to understand taxonomically, too unattractive, or too sterile to come into some use? What really is the situation? Certainly our species are difficult to understand and classify, but not insurmountably so and surely no worse than their Eurasian counterparts. Some find our species reasonably attractive to the eye and, by and large, they are readily found and brought into cultivation. More of these points later, but first let us look at the sterility question. Generally our native roses are quite fertile when selfed or crossed with other individuals of the same species and they may be fairly fertile if different species are crossed. This is really quite similar to our experiences with species elsewhere. What must be taken into consideration is the chromosome number of the species. One should only attempt to cross individuals having the same number for best results in plant breeding.

We have many species with two sets of chromosomes, the diploid group (one set with 7 chromosomes and usually expressed as $2n=14$, the diploid number), but only one has been used in breed-



Distribution of North American species roses, showing the great variance in genetic makeup as expressed by their chromosome numbers.

ing. Our prairie rose *(R. setigera)*, a species common in the midwest, was used with a *R. gallica* hybrid to develop a group of climbing roses, the earliest of which was known as the "Queen of the Prairies". Unfortunately *R. setigera* is the only native American rose plagued with sterility problems even though the chromosomes function normally. Other diploid species which could serve as sources of new genes include *R. nitida, R. palustris,* and *R. foliolosa* and also *R. blanda, R. woodsii,* and *R. pisocarpa*. Of all these species, only *R. blanda* has been used in a limited way in rose work, either as a hardy, often thornless understock or in crosses with other diploid species. For example, the Japanese *R. multiflora x R. blanda* produces interesting seedlings, yet these can only be considered novelty byways.

Turning to the second group of roses, the tetraploids, with four sets of chromosomes, we have fewer species but still a wide distribution across the continent. Each is complicated taxonomically and is what we call a plastic species, but each has attractive forms that might be directly adaptable to the garden, such as the double-flowered mutant of *R. arkansana*. However, this approach of introducing such novelties does little to incorporate desired characteristics of these roses into the main stream of the trade.

Still a third group having six sets of chromosomes is known in North America, the hexaploids. There are but two species and both have been used in breeding programs with some success. "Cantab" for instance is from a cross of the west coast *R. nutkana*, a vigorous species with large pink petals and large red hips, with the hybrid tea "Red Letter Day". And there are other such hybrids, each of particular interest to the sophisticated rose grower or to the grower with special needs.

Thus we have on the continent three major groups of native roses plus a minor octoploid variant (eight chromosome sets) of the hexaploids. Looking at their total ranges, we find that the hexaploids and octoploid are largely boreal in distribution, the many diploids widely ranging though not so northern in distribution, and the tetraploids more restricted to the United States.

If we assume that the plants are available for study, that they are desirable as roses, and that they have no complex sterility barriers, then we should also assume that there is need for a new surge of wide-cross breeding programs concentrating on species and modern roses with the same chromosome number. Since the majority

of our modern hybrid teas, hybrid perpetuals, and hybrid polyanthas are tetraploids, it seems logical to choose native tetraploids rather than diploids or hexaploids. Chances of sterility are far less, and long periods of selection to tetraploidize our plants, as was true for the original hybrid tea, are unnecessary.

Do our four native tetraploid species have desirable qualities worthy of incorporation into modern roses? My attention would focus on the typical form of *R. virginiana*, which is a hardy species, having a compact, small, shrubby habit, glossy somewhat disease resistant foliage, and deep rose petals. The fragrance is exquisite. The species is common from New England to Newfoundland and, less frequently, as far south as Delaware; it transplants readily and is highly fertile.

Why not start breeding with such an attractive American rose and see what would result after crossing it with hybrid teas, hybrid polyanthas, and others? It is clear that those in the past who have attempted to use new species in developing garden varieties have rarely had immediate encouragement, but then our knowledge today of cytogenetics and of plant breeding techniques is surely greater than even a generation ago. Much time will be saved by choosing a tetraploid like *R. virginiana* rather than seeking a diploid, hexaploid, or some plant of unknown chromosome number, and attempting to cross it with our modern roses.

It is time to start a sensibly planned, long term program to explore the possibilities of using our American species in modern rose breeding. If someone will accept the challenge of this project, a half century from now we shall be able to enjoy what the North American roses have contributed to horticulture. A whole new class of roses might emerge. □

Perennials for the St. Louis Gardener

Robert Dingwall

WITH THEIR ALMOST limitless variety in kind, height, color, and season of flower, hardy perennials offer the gardener a most satisfying return for his time and outlay. Once planted, they live on from year to year, and most of them increase in size. If a large selection is grown, and carefully chosen, there will be bloom from early spring until late fall. Early, midseason, and late flowering kinds should be planted.

Perennial borders should be located where they receive a lot of light and good air circulation so plants can increase in size from year to year and keep their normal height. If they have to search for sun and air, they become weak and leggy. If a partially shaded area is all that is available then care should be taken to choose varieties of shade-tolerant perennials.

A rich soil, not too heavy, is best for practically all perennials. It should be light and crumbly, well drained but moisture-retaining, and amply supplied with humus.

The best way to provide this is to dig at least 18 inches deep and work in a three inch layer of leaf mold or peat moss plus an inch of rotted manure or compost. Increase these amounts if your soil is poor to start with. To this add some bonemeal or organic fertilizer. If soil is excessively acid, a fact to determine by having a soil test made, it should be corrected by adding lime.

A traditional perennial border is one planted against a hedge, shrubbery, wall, or fence. These may be curving or straight, even

or varying in width. Beds up to eight feet wide are ideal but narrower ones can be equally effective if care is taken in choosing the plantings. Allow two to three feet between the hedge and plants placed closest to it due to the roots of the hedge taking the moisture and nourishment.

Low and medium plants look better in a narrow border than tall plants. A safe guide is to limit the selection of plants to those of heights not more than half the effective width of the border. Apply this rule to all borders and place the plants more or less in order of height, with the shorter-growing ones in front.

In planning the border, study other gardens and nurseries in your area. Study the catalogues of seedmen and nurseries that specialize in perennials. Watch for time of flowering, season of bloom, care of culture, color preferences, usefulness for cuttings, and so on.

When you have settled on the kinds and varieties of plants you intend to grow, make a rough plan to scale on graph paper showing where each is to be located. Take into consideration the height and habit of growth.

Usually three or more specimens of the same variety are planted to form a group. Space plants adequately to allow for plenty of growth and allow greater space between groups. The best effect is gained from having adjoining groups of somewhat irregular heights. Do not plant in adjacent groups the kinds that flower about the same time. Planning for continuity of bloom calls for careful placing.

Groups may be planted for contrast of color or an overall effect of color blending. The use of white flowers in a border helps to tie together and bring into harmony those colors that might otherwise tend to clash.

In selecting plants do not buy cheap plants from questionable sources. Visit a good nurseryman to make a selection of quality plants or order from a reliable dealer.

Perennials may also be grown from seed which is started in early June. Plants are grown in a greenhouse or coldframe until early fall when they are then planted in the border, while the soil is warm and quick establishment is easy. This allows the most time for roots to develop and assures the best possible display the following year. Spring planting can also be done, but there is then the danger from overdry soil following planting due to hotter weather and infrequent rains.

Paul A. Kohl

Hardy perennials, such as those in the Linnaean Garden, are truly satisfying to the gardener.

Give perennials a good start, and they should not need additional fertilizer the first season. After that, depending on the quality of the soil, fork in old manure, rotted compost or peat, together with an organic fertilizer each fall or early spring. Apply a mulch to the soil surface in late spring or early summer before the onset of hot weather. Be sure the ground is weed-free before spreading the mulch.

A well planned and planted perennial border or bed will go several years without a complete job of lifting and replanting. Nevertheless, it is advisable to undertake this task every fourth or fifth year. Plan this work for early fall. Lift all perennials except the few, such as peonies, which are known to resent root disturbance strongly. Label them carefully and heel them in temporarily by covering their roots with soil in a trench in an out of the way shaded corner until the soil preparation is completed.

Before the plants are reset, separate or divide the clumps into pieces, returning only the most vigorous and discarding all old, worn out centers.

TRIED AND TRUE PERENNIALS FOR ST. LOUIS GARDENS

Name	Variety	Color	Height	Full Sun	Semi-Shade	Date of Bloom	Comments and Soil Requirements
Achillea	Hybrids	Yellow	2′—4′	x		June-Aug.	Good cut flower. Well-drained soil.
Arabis	Snowcap	White	6″—8″	x		April-May	Shear plants after flowering.
Alyssum	Saxatile	Yellow	12″	x		April-May	
Allium	In variety	Mixed	6″—2′	x		May-June	Good cut flowers and showy in borders.
Aquilegia	McKana Hybrids	Mixed	20″		x	May-June	Likes soil rich in humus.
Artemesia	Silver Mound	Grey	9″	x			Ordinary soil, well-drained.
Aster	Alpinus	Blue	12″	x		May	Ordinary soil, well-drained.
Aster	Novi-belgii	Mixed	15″—40″	x		Autumn	Ordinary soil, well-drained.
Astilbe	Mixed	Mixed	1′—2′	x	x	June-July	Give ample moisture.
Aconitum		Deep Purple Blue	3′—5′	x	x	July-Sept.	Good soil.
Campanula	In variety	Mixed	6″—3′	x	x	Early summer	Good soil, well-drained.
Chrysanthemum	Maximum (Shasta Daisy)	White	2′—3′	x		Summer	
Coreopsis	Grandiflora	Yellow	2′—3′	x		Summer	Sandy loam, well-drained.
Delphinium	Hybrids	Mixed	4′—6′	x		June	Deep rich soil.
Dianthus	Pinks	Mixed	6″—2′	x		Summer	Well-drained soil.
Dicentra	Spectabilis (Bleeding Heart)	Red	12″—24″	x	x	April-May	Moist deep rich soil.
Doronicum	Caucasicum	Yellow	12″—18″	x	x	April-May	Deep moist soil.
Gaillardia	Aristata	Yellow and Red	12″—24″	x		Summer	Well-drained location.
Gypsophila	Paniculata	White and Pink	2′—3′	x		Spring and Summer	Good garden soil.
Helenium	Autumnale	Yellow and Orange	3′	x		Summer and Fall	Ordinary soil.

Name	Variety	Color	Height	Full Sun	Semi-Shade	Date of Bloom	Comments and Soil Requirements
Hemerocallis	Hybrids	Mixed	3′	x	x	Summer	Ordinary moist garden soil.
Hosta	Plantaginea (Plantain lily)	White	15″	x	x	Summer	Moist soil.
Iberis	Sempervirens (Candytuft)	White	9″—12″	x		May-June	Ordinary soil in dry sunny area.
Iris	In variety	Mixed	9″—30″	x		April-June	Good garden soil.
Lavandula	Spica	Blue	18″	x		Summer	Give some protection for winter.
Liatris	Spicata	White and Purple	3′	x		Late Summer	Good garden soil.
Lilium	In variety (Lilies)	Mixed	2′—6′	x	x	Summer	Good soil, well-drained.
Lobelia	Fulgens (Cardinal flower)	Red	1′—3′	x		Summer	Rich moist soil.
Lychnis	Chalcedonica	Red	3′	x		Summer	Well-drained soil.
Lythrum	Salicaria	Mixed	3′—4′	x	x	Summer	Good moist soil.
Monarda	Didyma	Mixed	2′—3′	x	x	Summer	Ordinary good garden soil.
Paeonia	Peony In variety	Mixed	2′—4′	x	x	Early Spring	Deep rich soil.
Papaver	Orientale (Oriental Poppy)	Mixed	2′—3′	x	x	Late Spring	Deep well-drained soil.
Phlox	Divaricata	Lavender Blue	12″		x	Spring	Well-drained moist soil.
Phlox	Paniculata	Mixed	2′—4′	x		Summer	Well-cultivated soil.
Phlox	Subulata	Mixed	2′—4′	x		Early Spring	Trim after flowering to keep compact.
Primula	Polyanthus	Mixed	9″—12″	x	x	Spring	Moist soil rich in humus.
Sedum	Spectabile	Rosy Purple	12″—18″	x		Late Summer	Ordinary soil.
Stachys	Lanata	Purple	18″	x		Summer	Well-drained soil.
Veronica	Spicata	Blue	15″	x		Summer	Ordinary soil.

In caring for the perennial border, care should be taken to control insects and diseases. Spray or dust only when needed and make sure you use the proper spray and keep it away from children, animals, and food containers. Safer sprays to use for insect control when needed are Rotenone, Pyrethrum, Sevin, and nicotine sulphate. For mildew and blights use Acti-dione, or Captan.

The cutting back of perennial plants is an important part of their care. Remove dead flowers to prevent seed formation. This encourages more flowering during the growing season and helps to control the height of the plant. Early spring plants such as dwarf phlox and alyssum should be cut back hard right after flowering to control shape and prevent growth of seeds. Divide and reset iris in late July.

The real danger to the survival of perennials does not come in the winter but during those periods of alternate thawing and freezing when the ground is bare of snow. Once growth has stopped in late fall the tops of taller growing plants such as peonies, phlox, and lillies should be cut back to two to four inches above the ground. To prevent the plants from leafing out during the freezing and thawing periods the plants should be covered with a light mulch that will not pack down such as coarse straw or hay. Do not apply the mulch until the ground is frozen in late fall and do not remove until all danger of heavy spring frosts are over. □

"Be it a solitary road-mender's hut with a few simple flowers growing by the door, or a great city with many acres judiciously laid out in shrubs and flowers, a garden is a sure way of measuring the strength of character of the people who live there."

Peter Skellerup
Chairman, Botanic Gardens,
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Visit Your Missouri Botanical (Shaw's) Garden

The Missouri Botanical Garden's main entrance is at Tower Grove and Flora Place. The Garden is served by both the Sarah (No. 42) and the Southampton (No. 80) city bus lines.

The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

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The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

Support your Garden and take part in Garden activities through the Friends of the Garden. Information may be obtained from the Main Gate or by mail or phone (865-0440).

MISSOURI BOTANICAL GARDEN

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Volume LVIII Number 5

September-October 1970

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The Missouri Botanical Garden is a Fund Member of the Arts and Education Council of Greater St. Louis.

From the Director

I HAVE JUST RETURNED from the site of the great oil discovery at Prudhoe Bay on Alaska's northern slope along the ice bound coast of the Arctic Ocean. This is a harsh, fragile, and limiting environment where life among the native plants and animals is strained to its limit and where migrant birds and animals come for only a few weeks each year. This is the land of the midnight sun and the winter night. Here is America's last great expanse of wilderness.

The total number of plant species does not exceed 200, a number which is few indeed when compared to other regions of the world where 1000 to 5000 plant species are not uncommon. Many of the genus names are familiar: *Equisetum, Calamagrostis, Poa, Festuca, Carex, Salix, Rumex, Ranunculus, Potentilla, Saxifraga, Artemesia, Mertensia,* and others. The species names are often those of the far north: *artica, alpinus, tundricola, frigidus, alaskanum, borealis,* etc. But the plants are small; their leaves and flowers hug the ground to avoid the everpresent wind off the ocean ice. Wind and cold, snow and ice, water and permafrost form the personality of the arctic tundra.

Great herds of caribou wander over the tundra during the summer and only recently moose have moved out of the Brooks Range to invade the north slope. The wolverine and wolf prey upon these large mammals as well as the small ones and represent the top of the food pyramid, except for Man who preys on everything.

The Trans Alaska Pipeline System probably will be built in this great land: Eight hundred miles of steel from Prudhoe Bay on the north coast to Valdez on the south coast of Alaska. Hot oil pumped out of the ground at up to 160° F remains hot as it flows through uninsulated pipeline towards the south. The tundra is a polygonal mosaic of ice wedges beneath the soil. Hot pipe would melt these wedges, sink into the soil, and fracture. Proper construction can prevent this and assure minimum damage to the tundra. Once again Man faces a decision to be made between *need* and *nature*. In this instance I am convinced that a proper balance can and will be achieved.

David M. Gates

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Illustration is from a woodcut of the small rock roses *(Cneorum tricoccum)* in John Parkinson's *Theatrum Botanicum* published in London, 1640.

Gardening in St. Louis

September and October

THE VIRGINIA CREEPER is already turning red on country ridges and chrysanthemums are becoming the focal point of gardens. The roses, thriving on cooler days and nights, are in their fall burst of bloom, and annuals have renewed vigor, too. Cutting of faded flowers plus maintenance of soil moisture will help keep a garden colorful until frost.

Lawns should be thoroughly soaked once a week if the ground is dry, and mowed as long as they grow. Bluegrass should be sown now. Use an all-round fertilizer such as 5-10-5 or 10-6-4.

Many perennials, biennials, shrubs, and trees will do best if planted at this time of year, before the ground freezes. The spring flowering perennials can be split and transplanted now, and bulbs set in soil at a rule-of-thumb depth of three times the height of the bulb. Deciduous hedges, particularly privet, should be trimmed for the last time in September. Peonies, Oriental poppies, and madonna lilies are best planted in late August and early September. Seeds of annuals such as corn flowers, bachelor buttons, calliopsis, larkspur, and poppies may be sown in the fall.

Before hilling up your roses for winter protection, apply 1/2 to 3/4 cup of bonemeal or 20% phosphate to each plant.

Don't let those leaves get ahead of you. Use them for mulch as well as for your compost pile.

Bring house plants and tender perennials inside before it freezes. Purchase ferns and other house plants now so that they may become accustomed to house conditions before winter.

Clean up cold frames and prepare their soil. Lettuce, spinach, and radishes may be started for late fall use. (Friends of the Garden: For free instructions on construction and use of cold frames, send your request and a stamped self-addressed envelope to the Education Department.)

This is a good time to review the work of the season, to bring one's garden notebook up to date, to evaluate successes and failures, and to jot down reminders for next year.□

Biennials for the St. Louis Gardener

Robert Dingwall

BIENNIALS ARE a group of plants which normally require two years to complete their life cycle (blooming the second season after seed is sown) before they produce seed and die. One group, known as true biennials, include Canterbury bells, sweet william, foxglove, hollyhocks, rose campion, honesty, and cowslips. These are best sown from mid-June to mid-July to obtain healthy, vigorous plants the following year.

The second group of biennials is comprised of pansies, violas, forget-me-nots, English daisies, and wallflowers. It is generally best

Claude Johnston

Foxglove *(Digitalis purpurea)* is a true biennial and blooms the second season after it is sown. The oldfashioned and elegant flowers are borne on stalks that grow three to four feet high.

TRIED AND TRUE BIENNIALS FOR ST. LOUIS GARDENS

Name	Suggested Variety	Color	Height	Full Sun	Partial Shade	Date of Bloom	Comments
Althea rosea Hollyhock	Powder Puffs	mixed	4′-5′	x	x	Mid-June	Often a perennial best grown as a biennial. Plant 2 ft. apart.
Bellis perennis English Daisy		mixed	6″	x		Early Spring	Like rich soil—Plant 6-8″ apart
Campanula medium Canterbury Bells		mixed	1′-4′		x	March-April	Rich soil—Plant 18″ apart
Cheiranthus allionii Wallflower		red and yellow	2′	x	x	April	Pinch back when small to encourage branching
Dianthus barbatus Sweet William		mixed	6″-15″	x	x	May and June	Plant 1′ apart
Digitalis purpurea Foxglove		mixed	3′-4′	x	x	June	Plant 1′ apart
Hesperis matronalis Sweet Rocket		mixed	2′-3′	x	x	May-July	Lovely scented flowers that usually self sow each year.
Lunaria Honesty or Silver Dollar		purple	2′-3′	x			Used for winter bouquets
Myosotis alpestis Forget-me-nots		pink, blue white	6″-10″	x	x	Early Spring	Good planted with spring bulbs. Likes slightly acid soil.
Viola tricolor Pansies		mixed	6″-8″	x	x	Early Spring	Start seeds in frame in August. Protect for Winter.
Primula polyanthus Cowslips	Pacific Hybrids	mixed	6″-10″	x	x	Early Spring	In some locations best treated as a bienniel.
Viola cornuta Violas		mixed	6″-8″	x	x	Early Spring	Same treatment as pansies.
Silene maritima rosea Rose campion		pink	12″	x		Early Spring	Average soil.

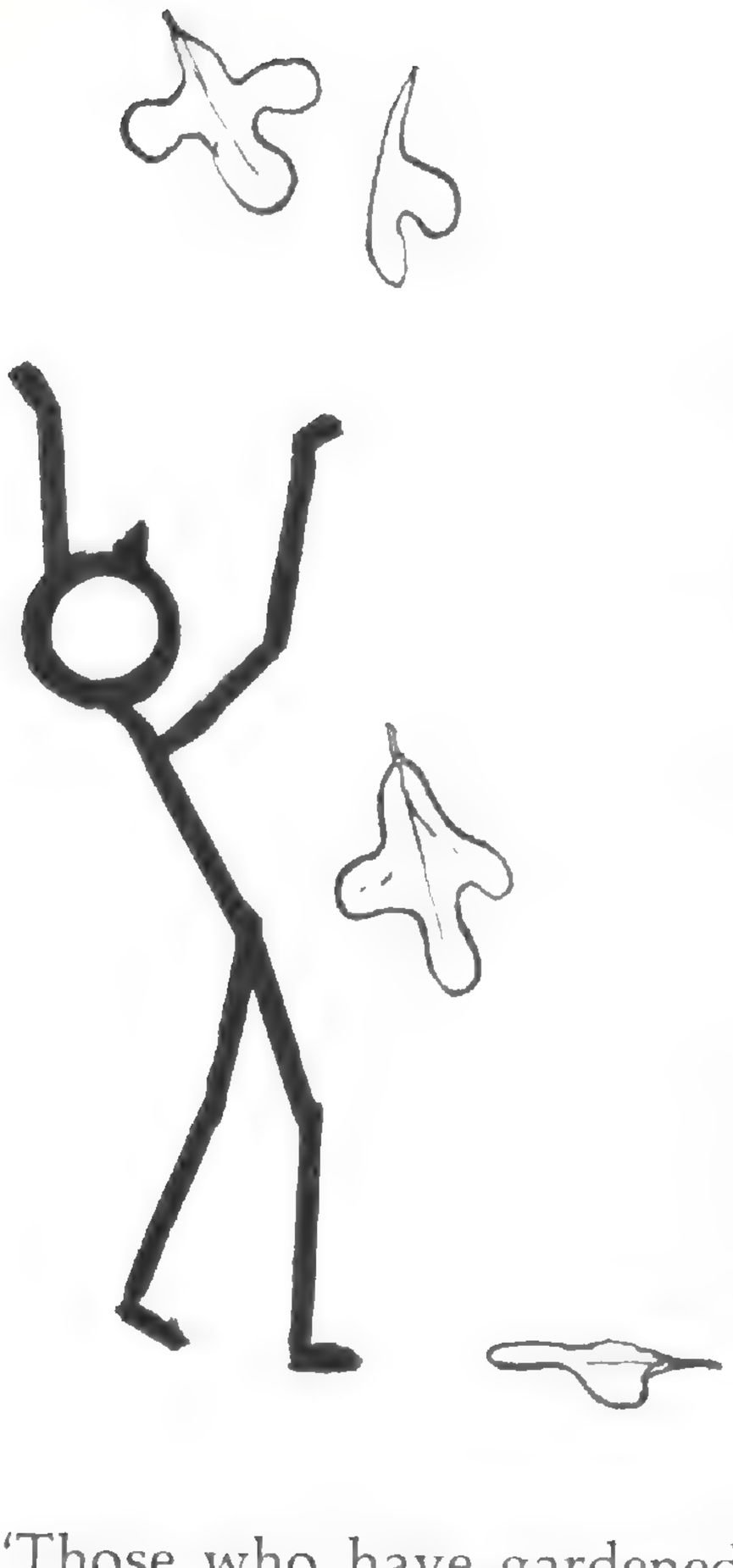
to sow this group in August to avoid danger of winter killing. As biennials are not usually as hardy as perennials, it is best to protect them from weather extremes by placing them in cold frames or mulching heavily after the ground has frozen.

Seed should be started as described in previous articles on annuals and perennials. Once seedlings develop their second pair of leaves transplant into nursery beds either in cold frames or in the open. Some people may prefer pots or flats with later removal to permanent beds.

Soil for biennials should be well prepared by adding leaf mold or other humus and well worked in as for perennials. Bonemeal may also be added to permanent planting areas.

In planting to permanent locations it is best to select a cloudy day. If you must move them in sunny weather, protect from hot sun. Plants should be moved with as much soil attached as possible. This is easier to do if the ground is well watered the day before. Dig hole large enough so as not to disturb the new plant too much. Pack soil well around each plant. Place 5-7 plants in each group for best effects. Water plants well immediately and repeat in two to three days if weather stays dry. Cultivate to keep down weeds or mulch lightly to conserve moisture and prevent weed seed from growing.

Care is needed to overwinter biennials. The more tender ones should be wintered in frames, keeping in mind not to let the temperature in the frame get too high at any time. Ventilate as needed. On very cold nights apply mats over the frame to hold heat inside. Others less tender can be left in the garden and mulched with an open mulch once the ground is frozen. Straw or old hay is ideal to use in this type of mulching. Do not remove the mulch too early in the Spring.□



THOSE LEAVES . . .

Edgar Denison

Well-known naturalist Edgar Denison is also a gardener of great experience and skill.

IN THE JANUARY-FEBRUARY 1970 issue of the Missouri Botanical Garden Bulletin appeared a book review by the late Dr. Edgar Anderson of Ruth Stout's *How to Have a Green Thumb without an Aching Back*. As the reviewer honors me by mentioning my creed in using large quantities of leafmold, I feel the urge to talk a little about leaves and compost and what gardeners can do with them.

May I first quote from the book review and then take my departure from there. Edgar Anderson writes: "Those who have gardened successfully in greater St. Louis have learned the importance of heavy mulching. A very few, Mr. Edgar Denison of Kirkwood for example, have carried it seemingly to fantastic limits and demonstrated what can be done by composting leaves. Now that leaves cannot be legally burned in St. Louis County, it is to be hoped that more and more county gardeners will work out convenient and tasteful ways of mulching the unwanted leaves . . ."

The reference to "seemingly fantastic limits" of using leaves and mulches goes back to the days when rotted sawdust from oaks was lying around wherever stavemills had operated, and that was almost everywhere. I hauled so many truckloads of this wonderful soil building material into my garden that Dr. Anderson predicted that my garden would turn into a bog. Unfortunately this interesting botanical event did not come to pass as the supply of oak sawdust disappeared. What was available free for the hauling is now an expensive item. There are still incredible amounts of sawdust to be obtained free for the hauling, but they are all at least 30 miles from St. Louis.

This brings us to the leaves. All my neighbors have always been encouraged to dump their leaves into my garden and I have carried leaves from wherever I can obtain them to my compost pile. Leaves present a formidable disposal problem only to non-gardeners. To the suburban dwellers who garden, leaves should be a most welcome gift as they form the raw material for soil management and mulching. In over 20 years of teaching Gardening in Adult Education and through innumerable discussion sessions with garden clubs I have learned that the use of leaves through composting is to most people a kind of mystery or, at least, an unnecessarily complicated project. Maybe this short discussion will encourage others to welcome and use leaves.

WHAT IS COMPOST? Compost is partially decomposed organic material, in our case from plants: leaves, grass clippings, garden refuse, small branches.

WHAT ARE THE USES OF COMPOST? There are two: Compost is a natural soil builder and it is an ideal mulching material both for summer and winter use.

Compost costs nothing but labor in the form of healthy exercise.

SOIL MANAGEMENT. Clay soils, the kind we have in the St. Louis area, have a number of undesirable characteristics. They hold water very well, the more so as they contain less organic material. They are sticky and plastic, tightly packed and thus prevent the admission of air, a prerequisite for root growth. They are cold, unmanageable, and once they do dry out they become as hard as concrete. The microscopic structure of clay shows stacks of platelets that stick together like wet plates of glass. It takes a long time before a dried out clay will absorb water. Our local clay soils contain only relatively small amounts of organic material, and being very old soils, they have lost much of the mineral content necessary to plant growth.

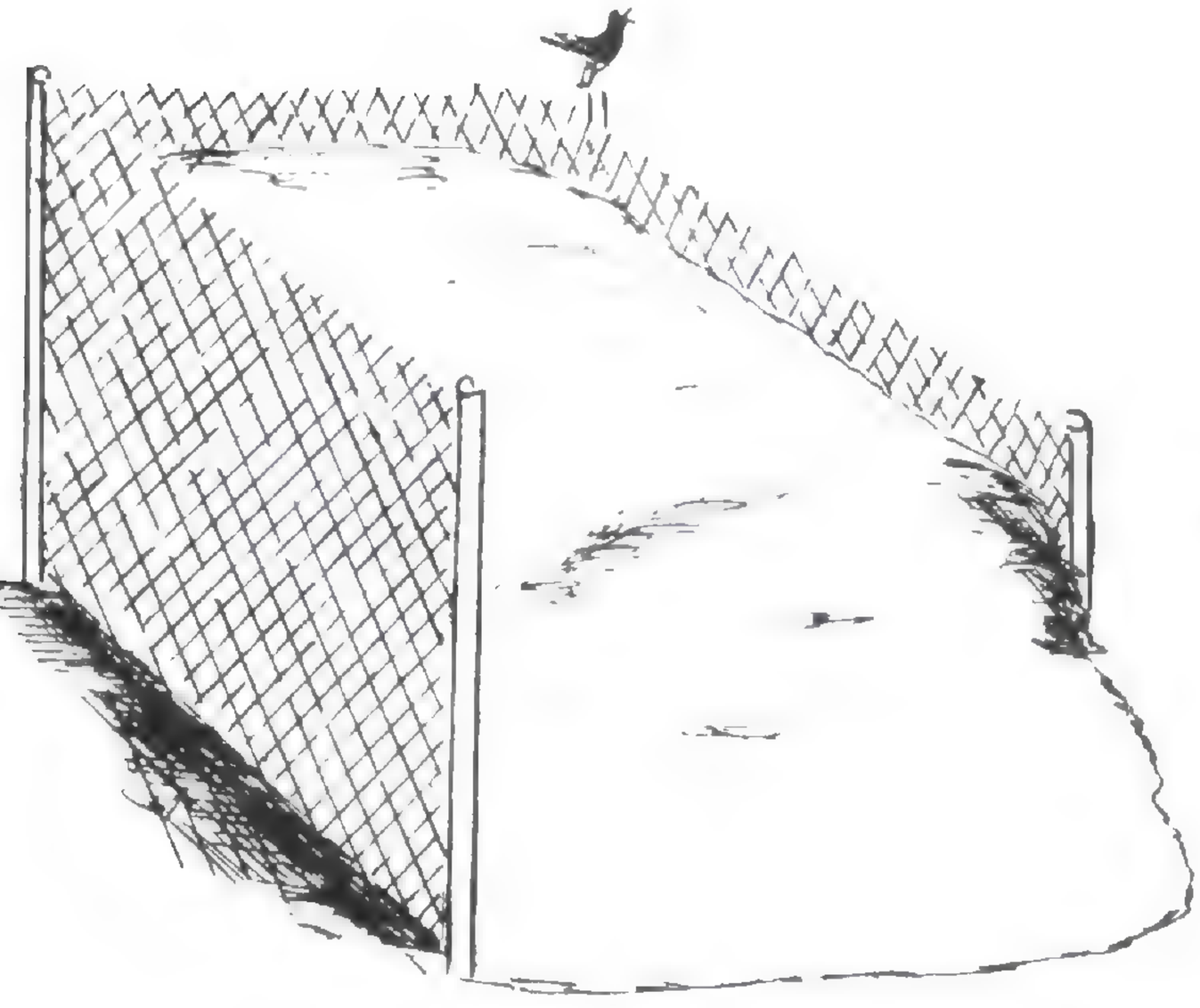
All these undesirable features with exception of the mineral deficiency can be corrected by the liberal admixture of compost. This must be done at that critical stage when the sticky clay soil has dried just enough so that the clods will crumble when hit by the spade or fork.

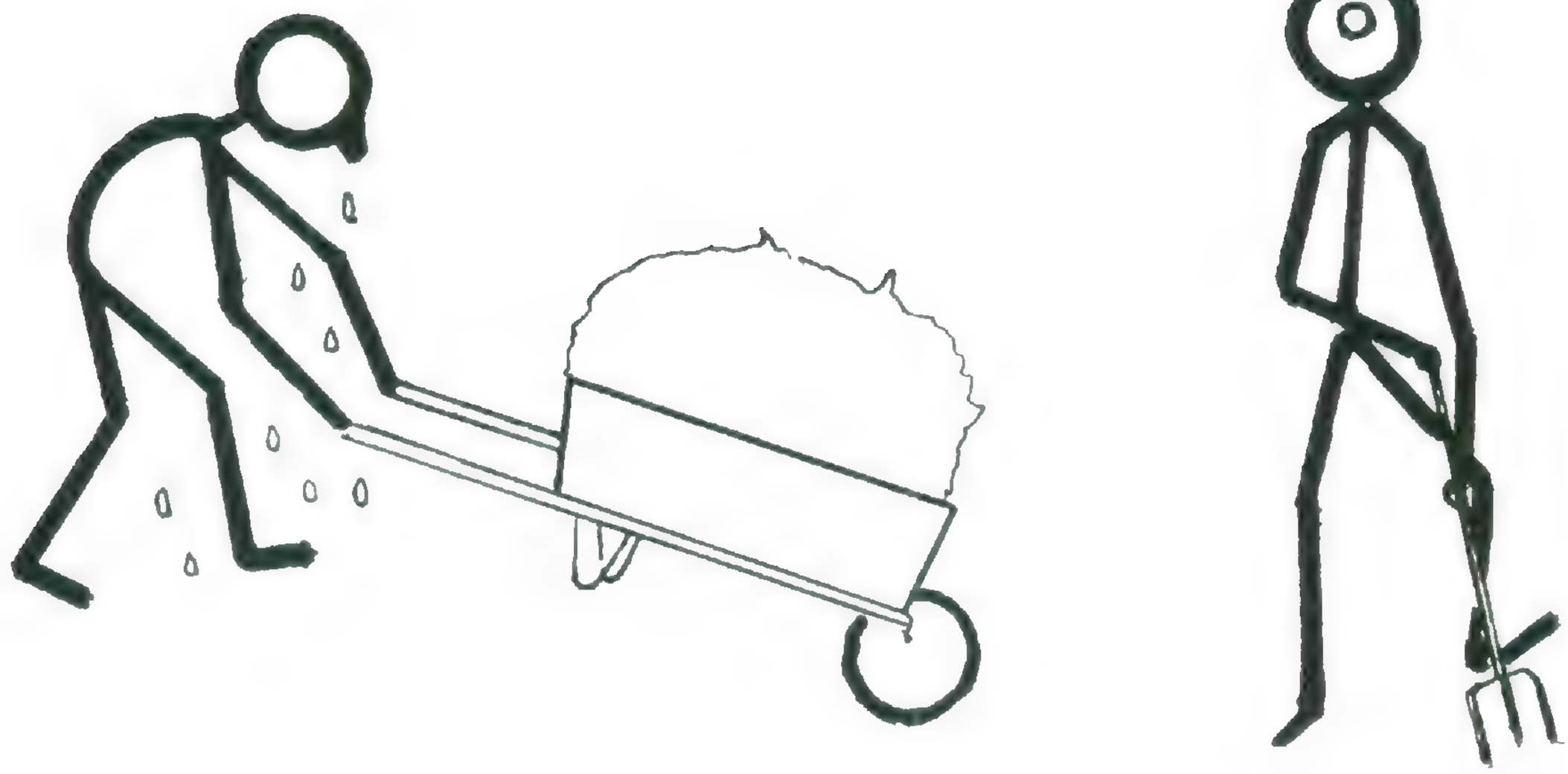
The mixture of clay and organic material (our compost is entirely organic) permits air and water to percolate through the soil thus encouraging the growth of roots. Unfortunately all organic

parts of the soil will ultimately be totally oxydized or decomposed, and this process is fast or slow in direct ratio to the amount of summer heat and moisture from rain or humidity. Thus, good gardening practice demands that organic material be replenished periodically. I replant and enrich the soil about every three to four years in borders and more often where vegetables or rows of flowers are planted. It is important to realize that one cannot provide organic material to an existing lawn. This must be done before sowing or sodding.

Ruth Stout advocates the mulching during summer of cultivated areas in the garden. This involves a problem in our midwestern climate. Summer mulching will be advantageous for at least three reasons: 1. it protects the soil from the splash of heavy rains, which cake the soil surface and thereby stop the necessary flow of air into and out of the earth. 2. it keeps weeds down, and 3. it "buffers" soil temperatures, protects the roots from the not so gentle oven temperatures of hot summer days.

But there is one problem with summer mulching, which must not be overlooked. A summer without a more or less serious period of drought is a rarity in St. Louis. Our local boosters who sing the praises of our climate must have very limited gardening experience. What little rain we get, must not be totally absorbed by a mulch but should ideally go entirely into the soil. Mulching material, consisting of compost, is water absorbent. Thus summer mulching means two





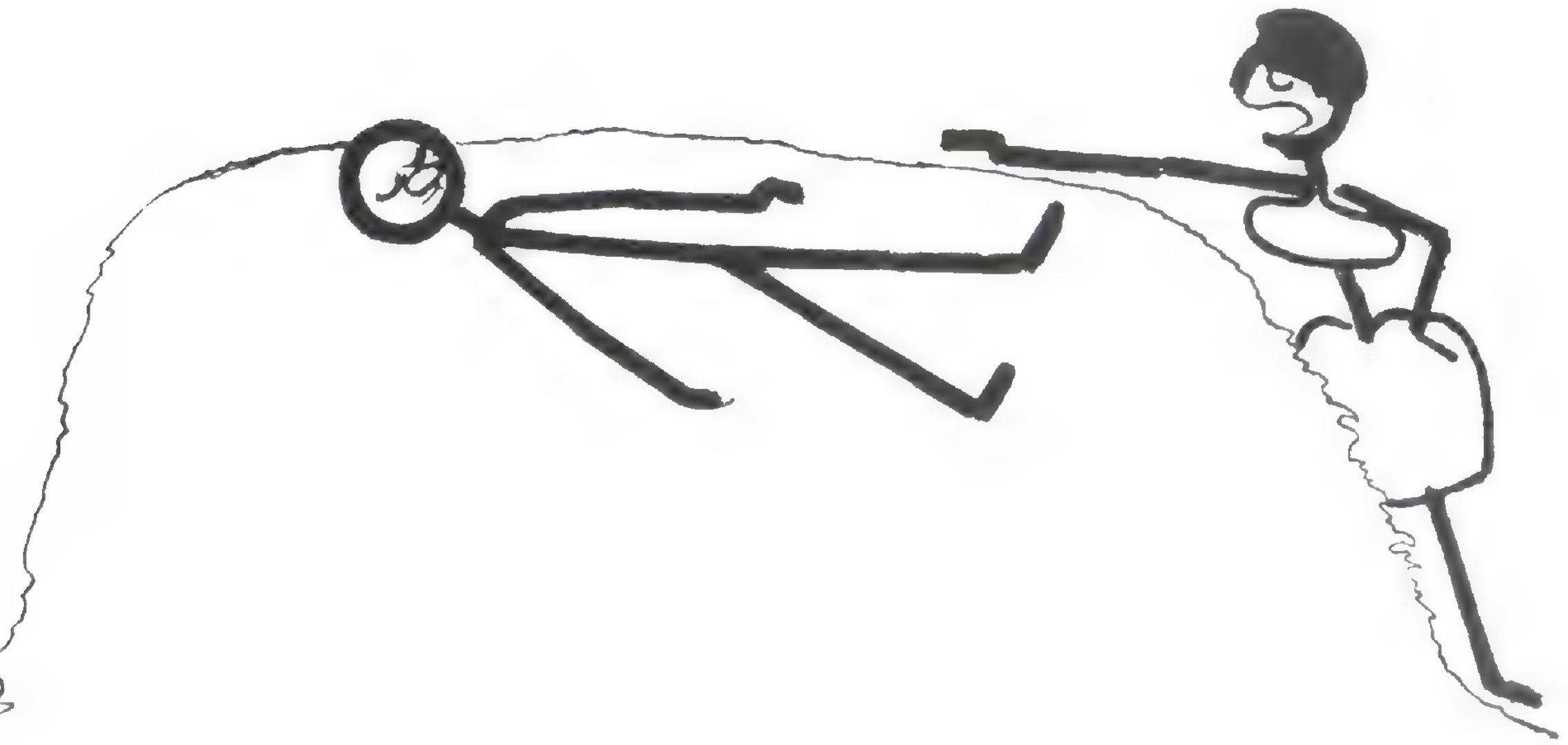
considerations: First, apply the mulch only after the soil has received a good supply of moisture, and second, compost-mulch may be raked into heaps or windrows when rain is indicated or before watering. How much work this involves depends on the size of the mulched ground and the availability of manpower (womanpower is at least as good) to do the job.

The use of compost as winter mulch is beneficial without qualifications. A three to five inch cover of mulch will provide a good insulation layer which will retard rapid changes in soil temperature, eliminate the heaving of plants by alternating freezing and thawing, and is specially appreciated by the small spring flowering bulbs such as crocus, scilla, snowdrops, grape hyacinths. The mulch will compact to about one inch by spring and should be left undisturbed. It is amazing how these small bulbous plants increase through seeds, which germinate readily in the compost medium.

HOW TO COMPOST. The one, universal excuse for not having a compost pile is "I have no space to dump my leaves." Behind this excuse lies the fear of an unsightly dump on an otherwise beautifully manicured garden. This fear is totally unfounded. A six foot high wire fence attached to four or more fence posts, in a rectangular shape with one side left open for access, will hold the leaves. If this is still not neat enough, then the fence can be surrounded by a sapling

enclosure. The compost pile should not be much higher than 6 feet after the leaves have settled, at least four feet wide (six or more feet is better), and not less than six feet long.

The leaves must be thoroughly wet when they go into the pile. This presents a problem when we have a dry spell, when the leaves come down, as was the case in 1969. Wetting the leaves with a fine spray from a garden hose for a fairly long period does not bring the same results as when the leaves are rain-soaked while on the ground. The bacteria which break down the leaves seem to be in the soil. Shaw's Garden used to get large amounts of leaves taken by City crews from the sewers. These leaves were of course thoroughly soaked and coated with dirt, and their decomposition to usable compost was completed by July, an amazingly short period of six to seven months. Decomposition demands three factors: moisture, heat, and air. We have talked about the moisture, and we do not need to worry about the heat as our climate takes care of that. The bacteria which perform the decomposing process need air. The easiest way to introduce air into the pile is to insert some old fence-posts or boards as we build it up. I do this when about one half the leaves have been laid down. Let the ends protrude out of the pile and give them a vigorous up and down shaking a few times during spring and summer. Better results would be obtained if the pile could be



turned over periodically, but that is such a back-breaking job, that I have never heard of anybody doing it.

This is all there is to composting. Let me give a few observations based on 36 years of composting in St. Louis and a few more in Europe:

• Compost is not a fertilizer: It is a soil conditioner. By all means use organic fertilizers on soils which have been enriched by compost.

• Oak leaves make fine compost. They are acid, when fresh, but by the time they have decomposed their "compost" is neutral. Why all that fear about acidity when most plants prefer an acid soil?

• All additives, regardless what claims are made as to their value in composting, are unnecessary and a waste of money.

• The same goes for lime—it is not needed and does not accelerate the decomposing process.

• The same goes for fertilizers or manure—they are not helpful in composting.

• Meat and fats should never be put on the compost pile as the bacteria which attack the vegetable matter cannot deal with them. Besides they attract rats.

• Grass clippings are a valuable component of a compost pile.

• Diseased plants are best burned, though the new anti-pollution laws may make this illegal. The heat created in the compost pile will kill many causes of diseases.

• How long does it take to get compost? It takes one year. The leaves put into the compost pile in late fall will be useable compost just before the falling of the next crop of leaves. There seems to be much desire to speed that schedule. The one year cycle seems to me entirely natural and fits well into the gardening chores of a year.

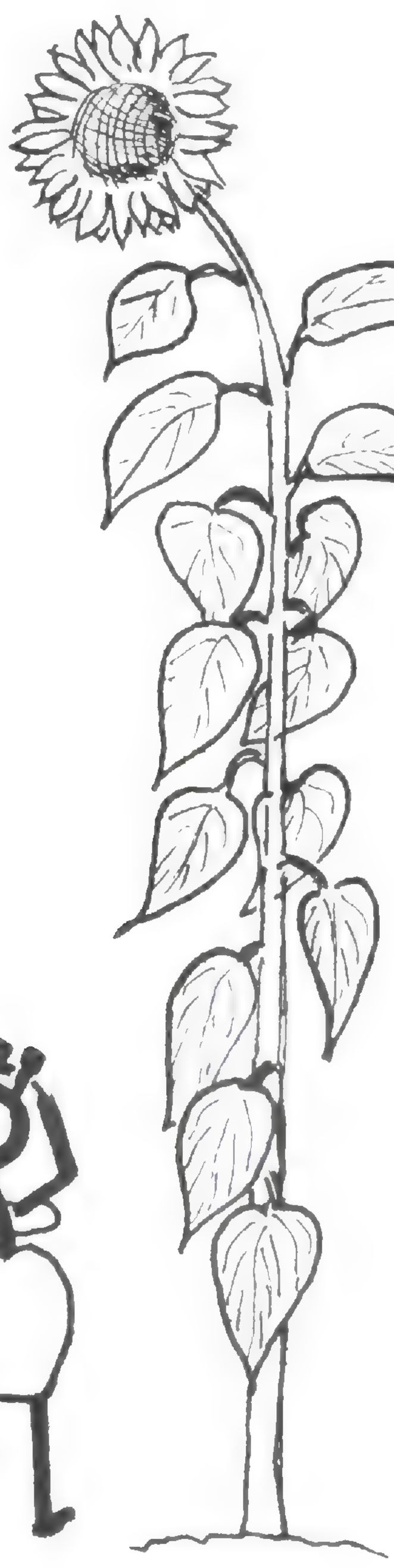
• It is not an easy job to break up a compost pile for distribution in the garden. A good spading fork is the best tool.

• In extremely dry summers it may be desirable to apply water to the pile, but normally this is unnecessary. The pile should preferably be so located as to catch all the rain without interference from trees.

• You cannot garden in pure compost as it will dry out too fast. It takes the combination of clay and organic material to make a good garden loam.

• You can raise seedlings in compost if you provide a constant supply of water. This is done to a great extent in England, and compost-raised seedlings are considered superior.

Let me say in closing, that composting is taken for granted by every European gardener; it is almost a way of life. We Americans have, unfortunately, "mined" our soils, thinking they were inexhaustable. Nature provided for reincorporation of leaves, grasses and roots into the soil . . . we can succeed only if we accept that principle. Composting is work but if you are a gardener you will enjoy the rewards of this labor. □



TATTERED BANANA LEAVES

S. Elwynn Taylor

IS THE EXTREME tattering of banana leaves an accidental result of wind damage, or is it a significant adaptive characteristic of the banana family? Most who have visited tropical climates have noticed that the leaves of the banana family *(Musaceae)* are shredded to the point that it is hard to imagine that no serious damage has been done to the leaf. When one looks closely at the leaves, it appears that very little damage is done to the leaf by tearing. The veins of the banana leaf are arranged such that it seems as if the leaf were designed to be torn. One can speculate that in high winds the tearing of the leaf along the vein lines saves the banana plant from blowing down. This in itself indicates that the tattering may be a significant leaf adaptation, but research at the Garden suggests that the tearing has several other implications.

A small leaf on a hot sunny day will be closer to air temperature than a large leaf. The rate of heat transfer from a leaf to the air is somewhat dependent on the size of the leaf; a small leaf transfers heat to the air more rapidly than a large leaf.

The effect of the size of a leaf on its temperature has been dramatically demonstrated using a Bird of Paradise *(Strelitzia nicolai)* growing in the Climatron. I tore one side of a leaf into strips 2-4 cm wide (about 1—1-1/2 inches) closely resembling natural tearing. Some weeks later the effect of tearing on leaf temperature was determined. I compared the temperature of the torn side with the side of the leaf that was intact. With the aid of a very special camera that is sensitive to temperature differences, a picture known as a

thermogram was taken. The mid rib proved to be quite cool; apparently transpiration is greatest near the mid rib and evaporative cooling is intensified there. The leaf is quite hot a short distance on either side of the mid rib. The highest temperature was 48° C (118° F) which is hot enough to kill the leaf. The leaf was more than 3° C (5.4° F) cooler at its edges. Tearing the leaf produced more edges, and hence the torn leaf had an increased proportion of its surface at the "edge temperature." When the environmental conditions are such that a tattered leaf heats to 46° C (115° F), an untorn leaf would die, being 3° C warmer. A leaf temperature of 49° C (120° F) is lethal to most members of the banana family.

S. Elwynn Taylor

One leaf of a Bird of Paradise *(Strelitzia nicolai)* in the Climatron has been torn from the edge to the mid rib forming many leaf strips about one inch wide. The tearing resembles that observed for members of the banana family growing in the tropics. Only one side of the leaf has been torn.

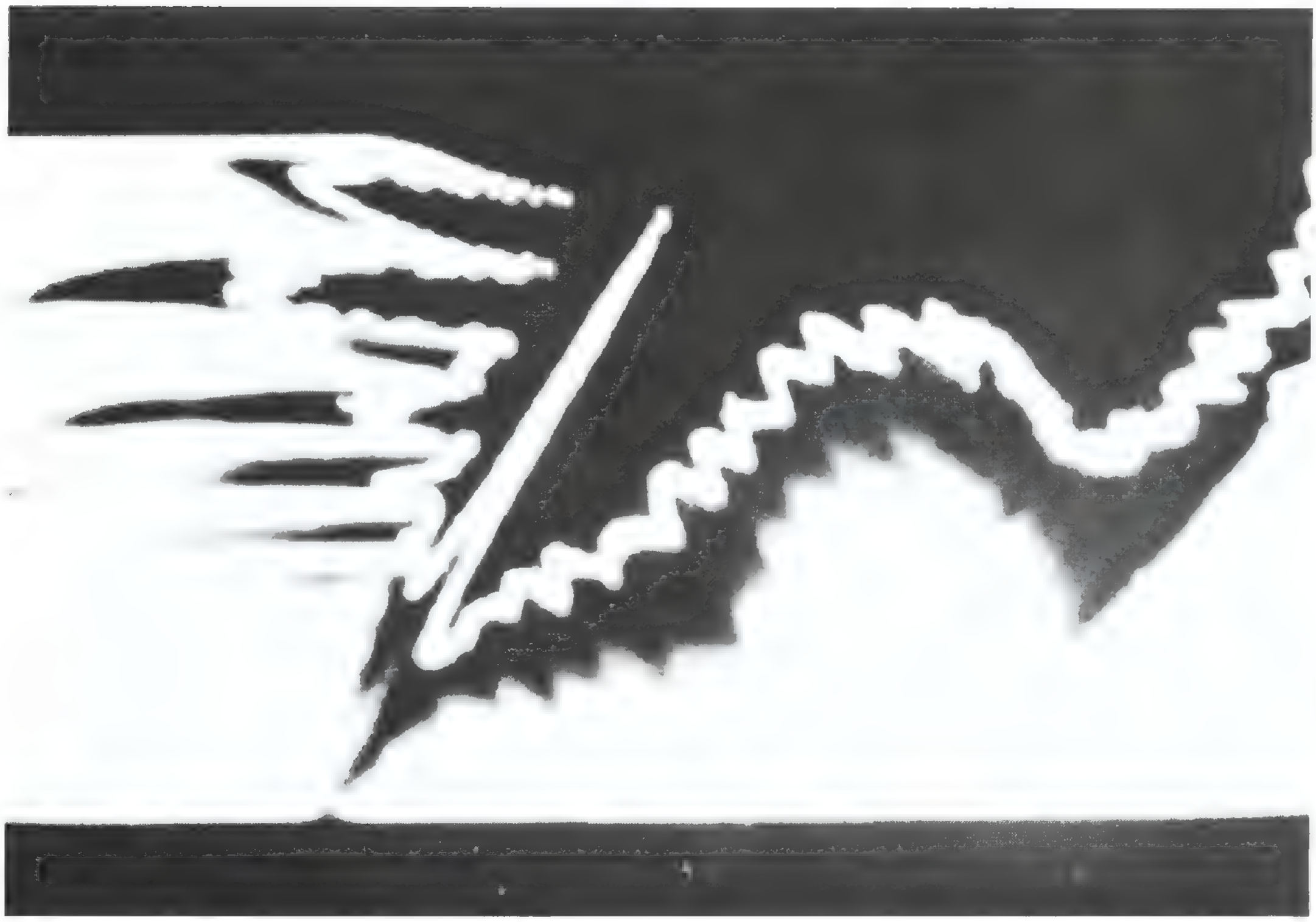
Tearing also has a marked effect on transpiration rate. The torn half of the leaf expended only one-third of the total water loss of the leaf. A torn leaf in this particular environment uses only one-half the water required by a similar untorn leaf!

Recent work in our laboratory points out another characteristic of the torn leaf. The net photosynthesis (productivity) is much higher for a torn leaf than for an intact one, partly because the torn leaf is at a more favorable temperature for photosynthesis. These is also an enhancement of CO_2 exchange from the air to the leaf. Carbon dioxide is taken into leaves and utilized during photosynthesis. Just as a small leaf transfers heat to the air more efficiently than does a large leaf, carbon dioxide is transferred from the air to the small leaf more efficiently.

In the Canal Zone the majority of leaves (or leaflets) growing exposed to full sun are less than 10 cm (4 inches) wide. Leaves this

S. Elwynn Taylor

No serious damage is apparent as a result of tearing. The torn side of the leaf gives the effect of many leaflets. When the plant is under extreme environmental stress, small leaves (or leaflets) are more efficiently cooled by evaporation and heat conduction to the air than are large leaves.



S. Elwynn Taylor

A heat sensing camera is used to make a thermogram (temperature picture) of a portion of the leaf. The edges of the leaf are near air temperature but the leaf temperature is considerably warmer than the air near the mid rib. The mid rib itself is disproportionally cool, probably because of a high localized transpiration rate. The divided side of the leaf averages much nearer air temperature than does the untorn side. When the leaf is exposed to high natural heat loads, the divided side will not suffer heat damage as severely as will the untorn leaf. The high temperature in the mid black area is 48° C (118° F); the white line indicates a temperature of 46.5° C (116° F) and the edge of the dark area where the picture disappears is 45° C (113° F).

small will be close enough to air temperature to prevent heat damage under the most extreme weather conditions occurring there. The banana family, however, is conspicuously out of place amid these small leaves, and the size of the banana leaves makes them very vulnerable to heat damage. It is entirely possible that the tearing so common in this family, rather than a mere result of high winds, is an adaptive characteristic enabling the banana to survive the harsh exposed tropical environment without severe thermal damage, without expending excessive amounts of water, and with enhanced net photosynthesis.□

Animals, Environment, and Ecology

Oscar H. Soule

ANIMAL ENERGY BUDGET WORK has been carried on at the Missouri Botanical Garden for several years under the leadership of David M. Gates, first with Warren P. Porter and now with Oscar H. Soule. The fundamental premise on which these investigations have been made is that organisms are in thermodynamic equilibrium with their environment. Thermodynamics is simply the study of the conversion of heat into other forms of energy and vice versa; this is fundamental to all relationships in biology.

If an animal takes in more energy than it loses on a long term basis, it will be heating up, and if it loses more than it takes in, it will be cooling off. The control of this equilibrium is often directed by the animal. The relatively narrow variation in the range of optimal body temperatures of animals, considering the wide range of temperatures found in their habitats, supports this.

Computers have been brought into play in an attempt to approximate the movement of energy into, out of, and through the animal, and thus show how the animal maintains the equilibrium. This artificial approach is extremely difficult and, at times frustrating since it becomes obvious that the animal is more adept than man in solving this complicated problem as it can maintain a reasonably constant body temperature in a fluctuating radiation and thermal environment. This can be seen more easily with the basic equation: ENERGY IN = ENERGY OUT. Each term can be broken down into more specific parts.

In general, ENERGY IN is made up of the metabolic heat produced by the animal and all the radiation absorbed by the animal from the environment, such as energy from the sun, sky, ground, walls, animals in a herd, or other sources. The ENERGY OUT equals

Infrared camera (right) and viewing screen with Polaroid attachment (left) which is sensitive to the temperature of objects rather than the light reflected or given off by them. The author is shown here in the enclosure constructed for photographing the rabbits.

re-radiation, heat radiated at the surface of the animal comparable to the heat given off by a light bulb; convection which is similar to hot air rising from a radiator; the conversion of water to vapor in the lungs and its expulsion from the body; conduction, the passage transfer of heat as from a hot radiator to something sitting on it; sweating; physical labor; and many others.

If the animal is capable of directing some of these avenues of energy exchange, it can briefly extend its range into an otherwise hostile environment. Man is the prime example of an animal taking advantage of this control, and no other animal approaches in this respect. However, other animals do use minor changes as part of their daily activity; and thus, can be active under conditions which otherwise

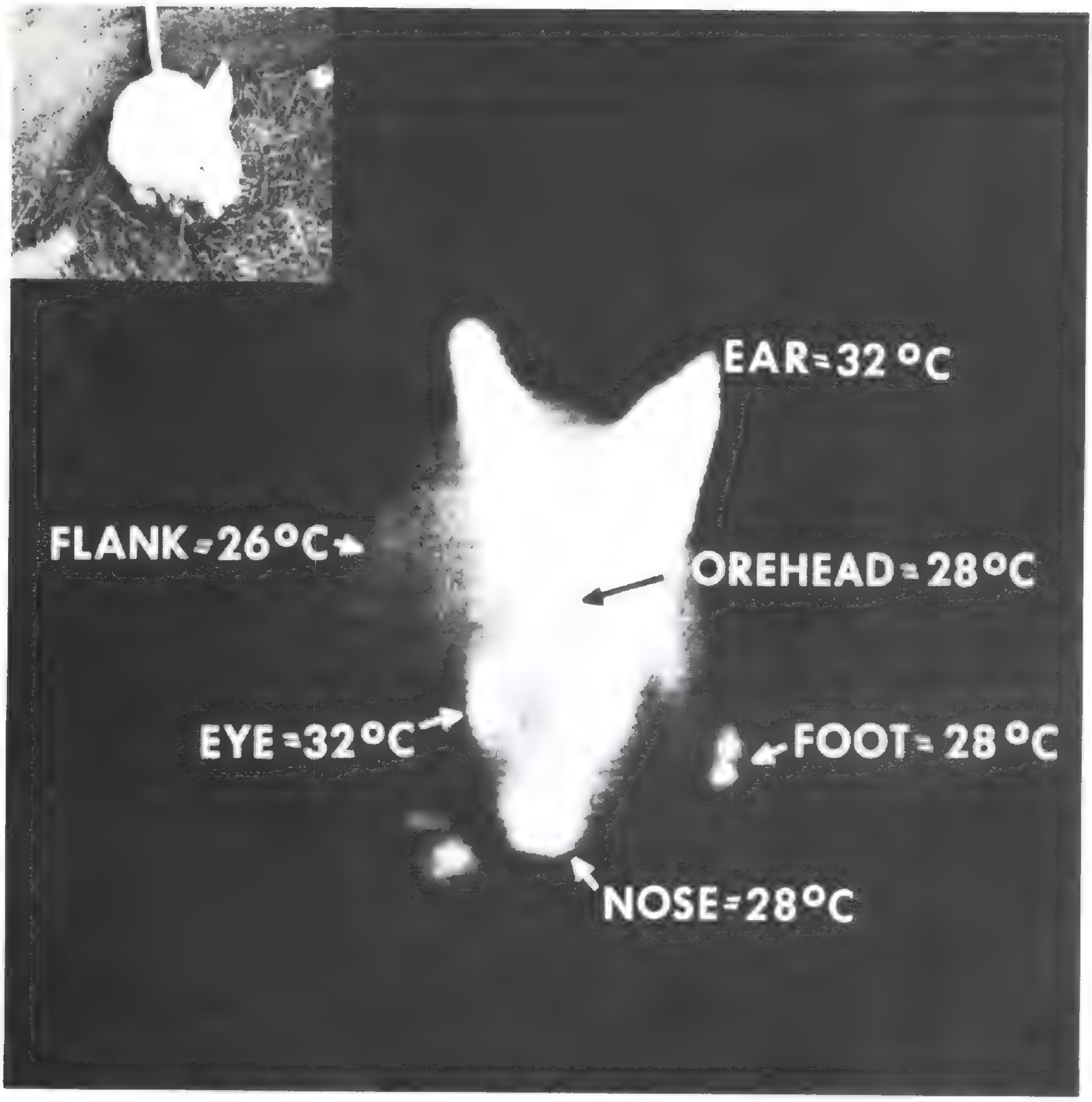
might be limiting. While the animal is solving the problem of energy exchange with the external environment, it also must contend with the heat flow from its core to its surface. Regulation of this heat flow is important in controlling the internal or deep body temperature, as well as influencing several of the terms stated above, such as re-radiation and convection. By simultaneous examination of these two problems, very accurate predictions can be made about the environment in which an animal may be found.

The recent emphasis shown in the "energy budget" approach to ecological problems has also seen development of new instruments to aid in quantification of these studies. One of these instruments is the Barnes Engineering Infrared Camera, Model T-101. This camera measures the temperature of the surfaces and presents these measurements as a visual display on a cathode ray tube. The camera on the right (page 19), views the inside of the black tarpaper enclosure. The cathode ray tube with a Polaroid camera attachment is being operated by the engineer on the left. The camera and technician were generously made available by the Barnes Engineering Company.

The Barnes Infrared Camera, sensitive to thermal or heat radiation, rather than visible or light radiation which stimulates the human eye, was used to make the thermograms of the white and black rabbits showing thermal radiation given off by the surface of the animals. Thermal radiation is found on the electro-magnetic spectrum with wave lengths between 2 and 15 microns. The human eye or light camera is sensitive only to visible radiation which is reflected off the coats of the rabbits. Visible radiation has wave lengths between 0.4 and 0.7 microns on the electromagnetic spectrum.* (One inch equals 25,400 microns.)

Instruments such as these have wide use in industry, space programs, medicine and biology. They have a direct application to energy budget problems. In a given physical environment, this camera shows graphically the temperature of different areas on the surface of an organism. This is important since not all the parts of the surface have the same temperature, nor do the different parts react the same to changes in environmental conditions.

**The electromagnetic spectrum includes, in order from low to high frequency; alternating current, radio waves, ultra-high-frequency (UHF) waves, infrared rays, visible light, ultraviolet rays, X-rays, and gamma rays. While all electromagnetic radiation travels at the speed of light, the wave lengths vary tremendously from 10-13 centimeters to infinity.*



White domestic rabbit as seen with the human eye (Inset.) The same domestic rabbit as seen with the infrared camera which is sensitive to thermal radiation. Note the differences in temperature on the head which are not apparent when seen with the eye.

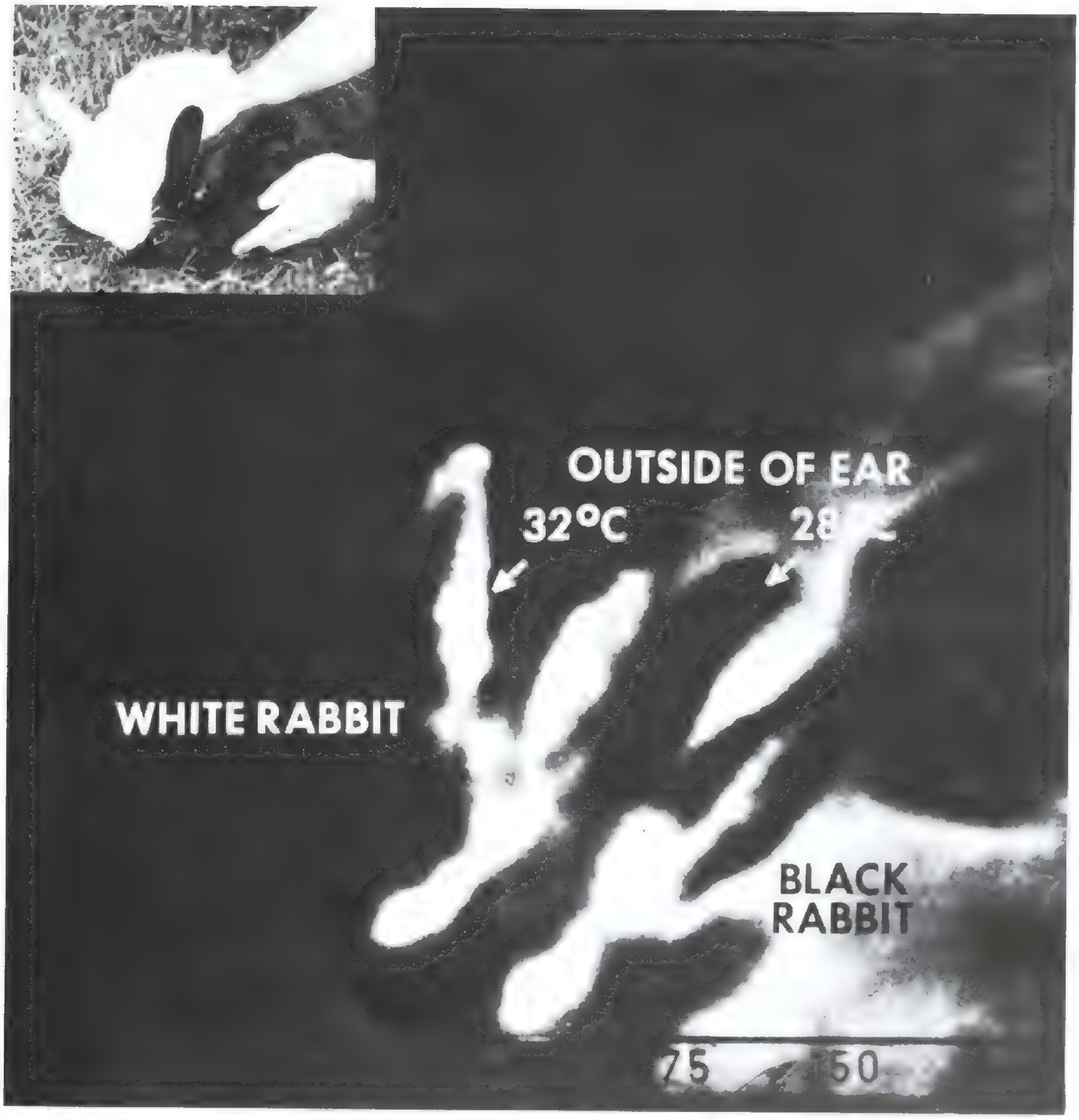
The white rabbit on this page has a surface temperature which is not uniform even though the fur color is uniform. Instead the rabbit has hot (light) and cool (dark) areas. In this case, the ears, eyes, and feet are warmer than the rest of the body. This becomes important in the balancing of the energy budget equation when ENERGY IN exceeds ENERGY OUT, since the animal can send the heated blood to these areas where some of the excess heat can be lost through re-radiation, convection, and conduction. Both ears and

feet will effectively lose heat by re-radiation. The ears are also important sites of convective heat loss and the feet effective sites of conductive heat loss.

The black and white domestic rabbits on page 23 appear as seen by the human eye. These rabbits were exposed to radiant wall heat of 26° C (79° F), tree-shaded ground temperatures of 22° C (71.5° F), and an air temperature of approximately 20° C (68° F) before and during the taking of these pictures. The same rabbits also appear on page 23 as they are seen with the Barnes camera. It is apparent that the outside of the ears of the white rabbit are warmer than those of the black rabbit. However, the remainder of the head of the white rabbit has similar temperatures to that of the black rabbit. The infrared camera provides information about the way animals adapt to their environment that otherwise would have been missed by the human eye or light camera.

Recently an evaluation has been made to see the effect of body dimension on the energy balance of animals. There are widely used rules in physiological ecology which involve size of animals. One such relationship is the power formula which states that certain physiological functions of animals can be expressed mathematically by using the weight of the animal in the formula. For example, the metabolism of a 1000 gram rabbit can be expressed in terms of the amount of oxygen consumed (milliliters per minute). Using the power formulas for metabolism, breathing rate, and the amount of air expelled per breath, it is possible to show how different body sizes affect the energy balance of an animal.

Prior to testing these calculations the weight of the animal was of primary importance in using the power formula. By substituting body dimensions for weight, it is now possible to predict heat inputs or heat losses for animals with different lengths and diameters. The comparison of a Saint Bernard and an Afghan hound is an example. While both have similar lengths, the bulky Saint Bernard has a diameter equal to a high percentage of its length as compared to the lean Afghan hound, where the diameter would be a small percentage of the length. The Saint Bernard would have a lower heat loss and greater heat input per unit of surface area and the Afghan would have a higher heat loss and lower heat input per unit of surface area due to their basic shape differences. If one considers the metabolic heat input in relation to where the animal occurs naturally, it is



White and black domestic rabbits (Inset) as seen by the human eye. The same white and black domestic rabbits as seen with the infrared camera. The thermal sensitive camera can not distinguish color, thus the white and black rabbits appear identical except for differences in ear temperature. This difference is not due to color, but to rate of blood flow to the ear which is a physiological process.

apparent that the higher relative ENERGY IN of the bulkier animal favors a colder climate and the more streamlined form favors a hotter climate. Though this is only part of the energy budget of these animals, it does show significant trends which will be discussed in more detail elsewhere.

The results of this study have yielded valuable information not only about the effect of body dimension on where an animal can live, but also by what means it can live. This becomes especially important in the comparison of ecological equivalents. It is possible through the work done at the Garden to change the variables in the energy budget equations and see graphically the compensation needed in the other parts of the equation for it to stay balanced. Shivering can serve as an example. This is a method of increasing metabolic heat input which in man can be up to eighteen times the basal production. If one shivered while the ENERGY IN = ENERGY OUT equation was in balance, the animal would be shifted to the ENERGY IN side. The organism would be required to compensate for this by sweating, panting, or raising the body temperature. While an animal does not normally shiver when the energy budget is balanced, it often enters the direct sunlight or is subjected to high air temperature which also increases the heat input. These require adjustments on the opposite side of the equation. The effectiveness of shivering is due to the shifting of conditions toward the ENERGY OUT side of the equation which occur with environmental combinations of low air temperature, lack of energy from the environment, and high wind speeds. By artificially controlling all parts of the equation except one, it is possible to see what value is needed in a single variable to balance the energy budget of the animal.

Animals are linked to the environment through their physical and physiological properties. It is through examination of modifications in these properties that one can interpret adaptation and evolution. With advances in instrumentation and new expressions of standard physiological principles, one can see how changes in body dimensions influence the tolerance of the animal to the physical environment.□

THE BUILDERS OF CAHOKIA MOUNDS AND THEIR CULTIVATED PLANTS

Leonard Blake
Hugh Cutler

THE GARDEN IS EXCEPTIONALLY well situated for studies on the evolution of plants. Such research is usually hampered by the scarcity of specimens from the past. Our studies on the origin and development of useful plants are based to a large extent on plants collected by people now long dead, preserved through fortunate accidents, and later recovered by archaeologists. Our research staff has long maintained contacts with institutions throughout the Americas and has built up excellent reference collections of specimens and publications.

Most work on plants used by ancient peoples has been based on materials from dry areas, but in recent years more and more has been done on those from the humid Mississippi Valley where ancient plant remains are seldom found except in carbonized form. Recovery has been stimulated by use of a simple water floatation technique and by the growing awareness among archaeologists of the value of faunal and floral remains in reconstructing the past. Methods have been developed at the Garden for measuring and analysing fragile bits of corn cobs and other plant remains. Among the collections studied here are those from 25 locations in St. Louis' own back yard, from the Cahokia Mound area in St. Clair and Madison Counties in Illinois.

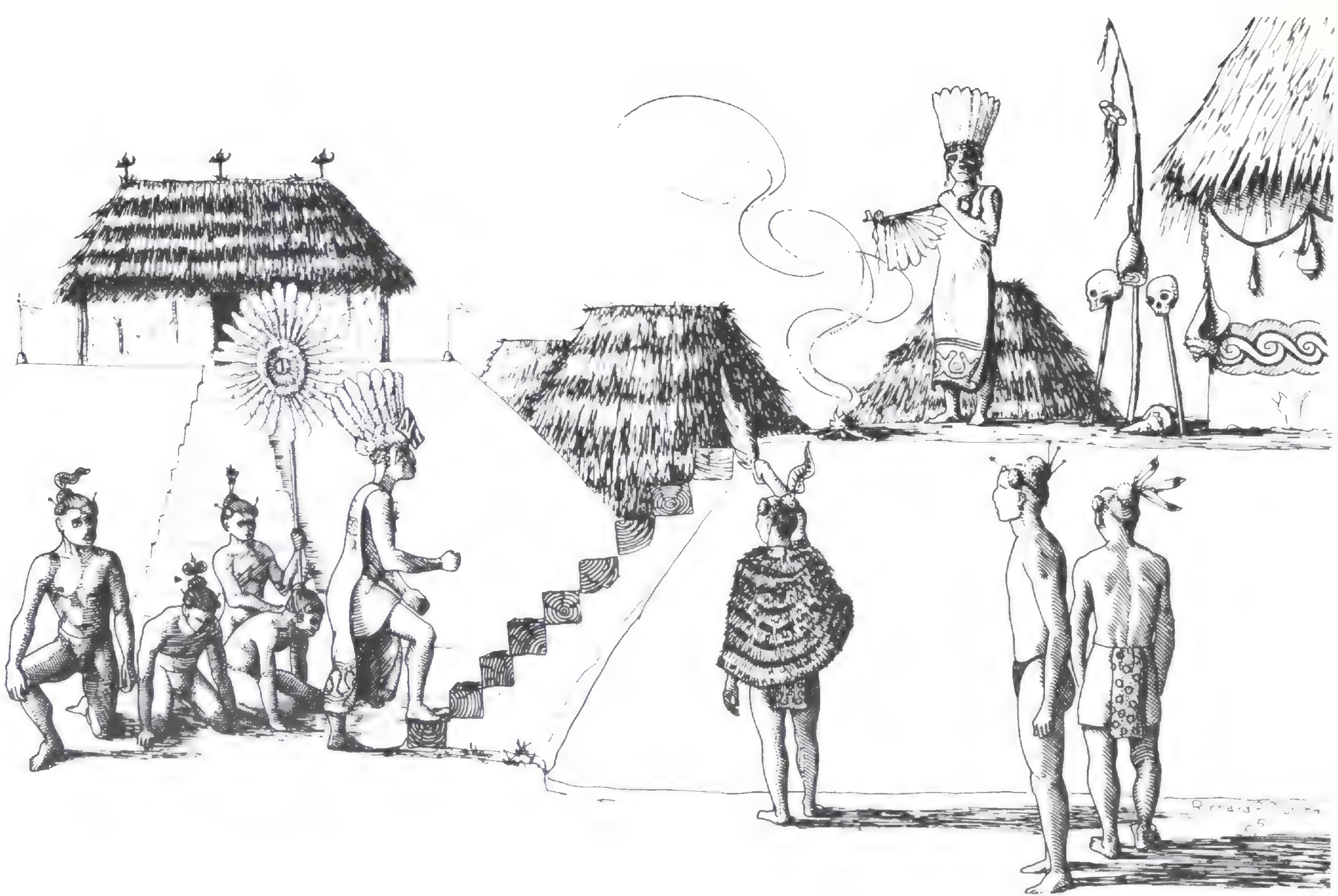
St. Louis was a center for the exchange of ideas and materials long before the first Europeans reached the Mississippi. Remnants

of the earlier center were so prominent that our city was called "Mound City" (and there still are 21 listings for firms under this name in the telephone book). The last large Indian mound in the city of St. Louis was graded down in 1869. It was 30 feet high and as large as a football field. The St. Louis mounds were in the western suburbs of the great complex centered about Cahokia Mound, which still stands across the Mississippi from St. Louis, protected in a state park. Built entirely by loads of dirt carried on human backs, it is the largest Indian mound in the United States. It rises 100 feet above its base on the south bank of Cahokia Creek and covers 14 acres. Recent excavations have shown that it was once surrounded by a large town enclosed in a stout palisade over 7800 feet long. In the past more than 100 smaller mounds and numerous settlements were concentrated along Cahokia Creek for six miles from the river to the bluffs.

More archaeological work has been done at Cahokia in the last 10 years than in all previous years. This activity has been stimulated by destruction of areas outside the park by highway and building construction. Recently digging has been done by groups from Washington University, Illinois State Museum, University of Illinois, Southern Illinois University, University of Wisconsin at Milwaukee, Beloit College, and Gilcrease Institute of Tulsa.

Large, flat-topped mounds, such as the great mound and many others at Cahokia, apparently were platforms for temples, mortuary houses, or dwellings of sacred leaders. DeSoto and other early explorers saw Indians using this kind of mound for these purposes in the southeast where old customs persisted. The outline of a structure 65 by 135 feet was uncovered on the topmost terrace of the great mound by archaeologists working for Washington University several years ago. Similar evidence has been found on other flat-topped mounds elsewhere. An ordinary dwelling house in the town that surrounded the mound seldom covered an area as large as a two car garage.

This illustration shows an artist's interpretation of a Mississippi Indian town. The great towns and ceremonial centers of these farming Indians had the important buildings or temples placed on mounds. The chief, who was believed by his people to be related to the sun, is shown ascending the stairs of a temple to be met by the priest. They will greet the rising sun together and show him the way across the sky. (Illustration by permission of The James Foundation, St. James, Missouri.)



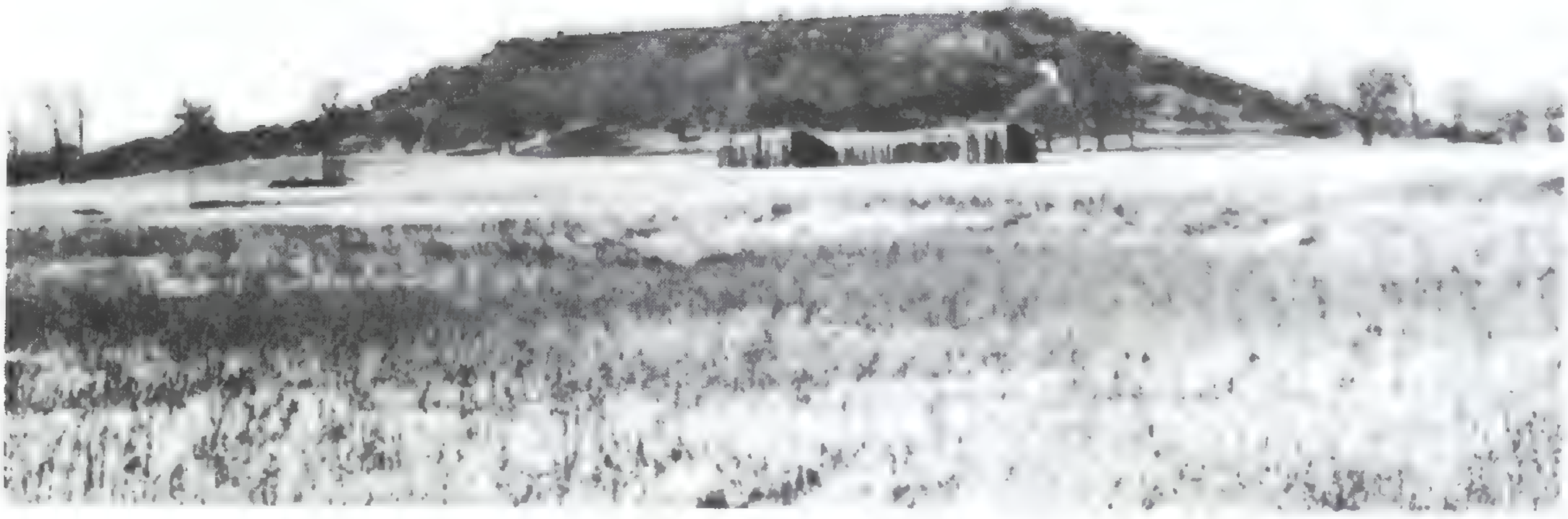
Cahokia had trade and culture contacts from Florida to Oklahoma and the Plains, and as far north as Wisconsin. Archaeologists agree that, while there is no evidence of a mass migration out of Mexico, temple-topped mounds along Cahokia Creek are a northern reflection of temple-topped pyramids of Mexico.

Carbon 14 analyses of charcoal samples indicate that some of the settlements date from before 800 A.D. and that work on the great mound began near 900 and stopped abruptly around 1150. There appears to have been a slow declining trend in population from about that time on, although many smaller mounds were built afterwards. There was some occupation in the area as late as the early 16th century but by historic times these people were gone.

Recent studies of climate suggest that summers began to become cooler and dryer around 1200 A.D., which could make the growing of the kind of corn which prevailed at that time at Cahokia more difficult. Corn apparently was the food base which made massive mound construction and complex ceremonial activity possible. Lessening corn yields may have accelerated population decline, particularly since the old kinds of corn were retained longer at Cahokia than at nearby places.

Carbonized plant remains are not found at random throughout an archaeological site. They are most often recovered from abandoned storage pits which were later filled with trash. If a dwelling house burned, which happened frequently because of thatch roofs, food plants on the floor or hung on the rafters became carbonized and so preserved. Shallow concentrations of charred corn cobs sometimes found at Cahokia and elsewhere resemble the debris of smudge pits that historic Indians made for smoke tanning hides. The most unusual source of plant remains at Cahokia was from a large pit 15 feet below the present surface, under a small mound known as Mound 51.

Charles Bareis of the University of Illinois, after excavations in the pit over parts of three summers, is convinced that this pit was one source of dirt to build Cahokia Mound. About 1000 A.D. the Indians started filling the pit with garbage and covered this with a layer of grass which later burned. They then filled the pit completely and built a 15 foot mound on top of it. In and below the burned grass layer was a treasure trove of plant remains. Corn Cobs, squash and gourd rinds, and, incredibly, uncarbonized squash seeds were pre-



Leonard Blake

Cahokia Mound stands across the Mississippi from St. Louis, protected in a state park. It rises 100 feet above its base on the south bank of Cahokia Creek and covers 14 acres.

served for ten centuries by being sealed from the air by pressure of the earth above them.

The oldest corn from Cahokia is mainly small and 12-rowed. It is a very hard flint or popcorn similar to Mexican races Chapalote, Reventador, and Nal-tel. It has been found in one Midwestern site of about 280 B.C. and on several of about 1 A.D. It persisted until historic times when very small amounts were grown by practically all Indian groups north of Mexico. This kind of corn predominates in the collections from under Mound 51 and from the Kane site of 900-1050 A.D., a small settlement near Cahokia.

Most recent corn at Cahokia is of the Northern Flint race. This is an 8-rowed corn with greatly thickened cobs, with kernels broad as long, and with greatly enlarged shanks. 8-rowed corn goes back at least to 1 A.D. in the Midwest and is known from earlier sites in the Southwest. Northern flint, in its developed form, is better adapted to low temperatures and a short growing season than the old many-rowed flints and popcorns. At the time of first European con-

tact it was grown as far north as Montreal. This is the kind of corn that the Pilgrims learned to plant under the direction of Squanto of the Wampanoag Tribe.

The general pattern of development of corn in the Midwest is for the old, small, hard flints and popcorns to be followed slightly later by some 8-rowed ears which become more common as time goes on. There is a gradual increase in hardness of the cob and size of the ears. The trend from many-rowed to 8-rowed ears is gradual, a result of environment and human selection within the kinds grown in the region and the kinds introduced, mainly from the south and west. Vary few kinds of corn can be moved rapidly from low latitudes to higher ones, because most are strictly adjusted to certain day lengths, as is the case with many other plants.

Cahokia corn follows the general pattern for the Midwest, but is generally more conservative and southern in character. This may reflect retention of old varieties typical of ceremonial areas in the Southwest, continued connections with certain parts of the south, or slightly better growing conditions and techniques.

A small part of the evidence may illustrate what we mean. Only 6% and 10%, respectively, of the collections from the nearby Kane site and Mound 51, mentioned above, are 8-rowed, but 29% are 8-rowed from a settlement of similar people of about the same time period, who lived only 30 miles to the east. Although we have few well dated collections from the period of late occupation at Cahokia, some adjustment to changed weather patterns appears to have been made, either voluntarily or by environmental selection. 42% of a collection which dates around 1300-1500 A.D. is 8-rowed.

The words "squash" and "pumpkin" are popularly used for several different species of *Cucurbita,* usually "squash" if the fruit is eaten green and "pumpkin", if eaten when yellow and ripe. All of the true squashes are of American origin. The prehistoric Indians in the Mississippi Valley cultivated only one species, *Cucurbita pepo* and a subspecies, *C. pepo,* var. *ovifera,* now grown only for decoration and popularly called "egg gourd". Jack-o-lantern pumpkins, patty-pan, acorn, and zucchini squash are some of the true squashes *(C. pepo)* which are cultivated today. There is evidence from archaeological excavations that this species was being used by man as early as 7000 B.C. in Tamaulipas, Mexico and grown in eastern United States by 400 B.C. The species and often the variety of archaeological

specimens may be identified by their seeds, peduncles (stems), and sometimes by their rinds.

The numerous uncarbonized squash seeds recovered from under Mound 51 are mostly those of a small pumpkin type of *C. pepo*. There also are some smaller ones that appear to be from a variety with a smaller fruit that was probably eaten green. Several peduncles were preserved uncarbonized and one of these was of the egg gourd form, variety *ovifera*. A single carbonized seed of *C. pepo* was found near a house floor under a 17 foot mound just east of the great mound and a piece of carbonized rind in another mound nearby.

The bottle gourd, *Lagenaria siceraria*, may be distinguished from the squashes by its seed, hard rind with distinctive cell structure, and its fruit stem. The plant has white, night-blooming flowers. The fruits are extremely variable in shape. Wild relatives are most numerous in Africa, where the species is believed to have originated, but seeds and rinds from cave deposits in Tamaulipas, Mexico, have been dated at about 7000 B.C. by the Carbon 14 method. Early presence

Leonard Blake

Archaeologists from the University of Illinois – Urbana excavating a series of Indian houses built near Cahokia Mound.

of the gourd in the New World is currently believed to be the result of ocean drift rather than human agency. 600 B.C. is the earliest date for this plant in eastern United States. A human feces found in Salts Cave, Kentucky, contained an undigested gourd seed. The hard outer shell of gourds were and are used nearly everywhere for containers. There are few records of the use of the bitter flesh for food. Shapes of some of the pottery vessels used at Cahokia are identical to those of gourd fruits.

Several badly charred seeds recovered by water floatation from the Kane site defied identification. One a little less damaged than the others retained some of its outer coat and was tentatively identified as gourd. Experimental charring of modern specimens of gourd seeds produced objects which matched the previously unidentified seeds. There were several pieces of gourd rind among the material discovered under Mound 51 and another small carbonized fragment turned up at another location.

In all the samples of plant remains from Cahokia, the common or kidney bean *(Phaseolus vulgaris)* is represented by only two halves of beans, each from a different location. The common bean, which is a native of the New World, was cultivated in Mexico as early as 3000 B.C., and in the Southwest by 1 A.D. Although it may have been grown in the Midwest this early there are, as yet, no certain, well dated records of its presence before about 1000 A.D. Beans provide an excellent source of protein, supplementing that in corn to provide a balanced diet, without the use of meat.

Only a fraction of the plants grown by the Indians have been preserved and recovered. There are still a great many things we would like to know, particularly, about the most important crop, corn. What did the Indians consider the ideal within the range of kinds grown at Cahokia? Caches of selected varieties may give a clue. What was the range of variation in fields of single kinds of corn? Future discovery of large masses from graneries may show something of this and suggest the effect of environment and agricultural techniques on crops. Effort, good fortune, and time may bring answers to some questions, but never to all. □

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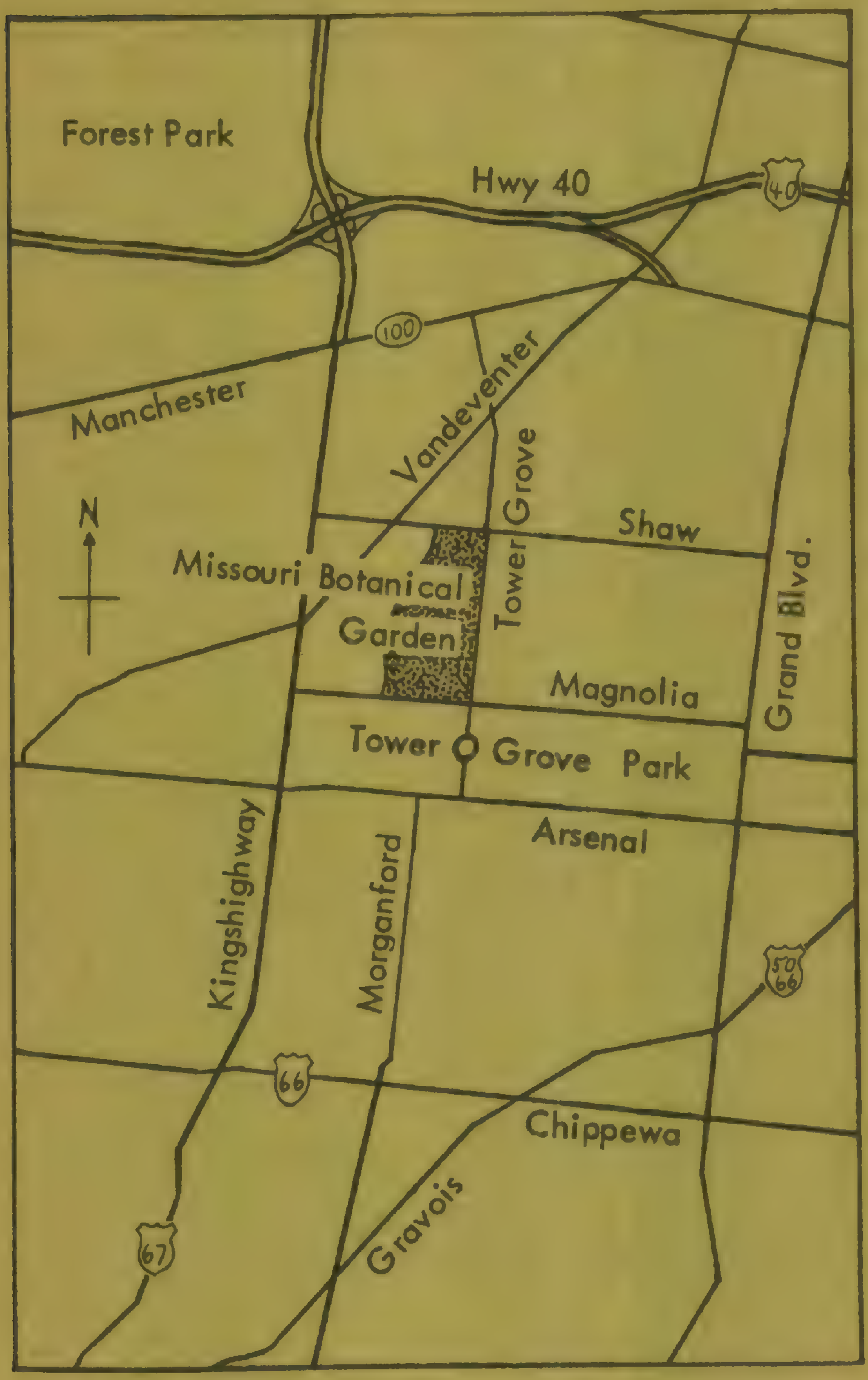

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MISSOURI BOTANICAL GARDEN

BULLETIN

VOLUME LVIII NUMBER 6

NOVEMBER-DECEMBER 1970

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From The Director

LIFE IS BECOMING more complex for mankind year by year as the number of humans on Earth doubles and redoubles every thirty-five years; as open space and wilderness regions become distant memories; as human refuse and debris smother the landscape; as the global atmosphere becomes laden with pollutants and climates change; and, in particular, as the problem of feeding a massive population becomes ever more precarious. Mankind must learn to achieve the management of man. Critical to the successful accomplishment of population control, of adequate nourishment, of open space, of abundant recreation, and of clean air and water is the study of plants to use in furthering these purposes.

For years Indians in the Amazon basin have used derivatives from the roots of sedges as contraceptives to control their population. Our world's peoples must without a doubt also find a way to control their numbers.

The United States corn crop, seriously damaged by a new mutant fungus during the summer of 1970, showed its vulnerability to over-selection. Many varieties of modern and of primitive corn must be maintained for backcrossing in order to produce corn with a capacity to resist many pathogens. New food plants, many already known to primitive tribes, are desperately needed by modern man.

Complex societies such as ours find an increasing need for medicinals and pharmaceuticals to treat a diversity of diseases and nervous disorders. Many subtle rare alkaloids and other drugs are to be found in the tissues of plants from remote regions.

It is absolutely self evident that not only the health and sanity of high density populations of people but the very survival of many human beings depends increasingly upon the world of plants. The Garden's Herbarium, one of the world's greatest collections of preserved plants, is an invaluable resource for modern biological research. The staff of the Missouri Botanical Garden is totally dedicated to the discovery of plants, to the understanding of plant evolution, and to the application of this knowledge to man's welfare.

David M. Gates

MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME LVIII NUMBER 6 NOVEMBER-DECEMBER 1970

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the sweet ground pine *(Ajuga chamaepitys)*
in John Parkinson's *Theatrum Botanicum*
published in London, 1640.

Gardening in St. Louis

November and December

THESE ARE THE "composting months" when nature's gift to the soil is free for the raking! Refer to Edgar Denison's article, "Those Leaves," in the September-October issue of the *Bulletin* for great advice on how to build a compost pile.

Protect shrubs, perennials, and newly planted trees with compost or leaves. Roses should be cut to no more than three feet high after heavy frost. Mound two or three shovelsful of soil, compost or sawdust around the roots for protection against the alternate freezing and thawing so harmful to the bud graft.

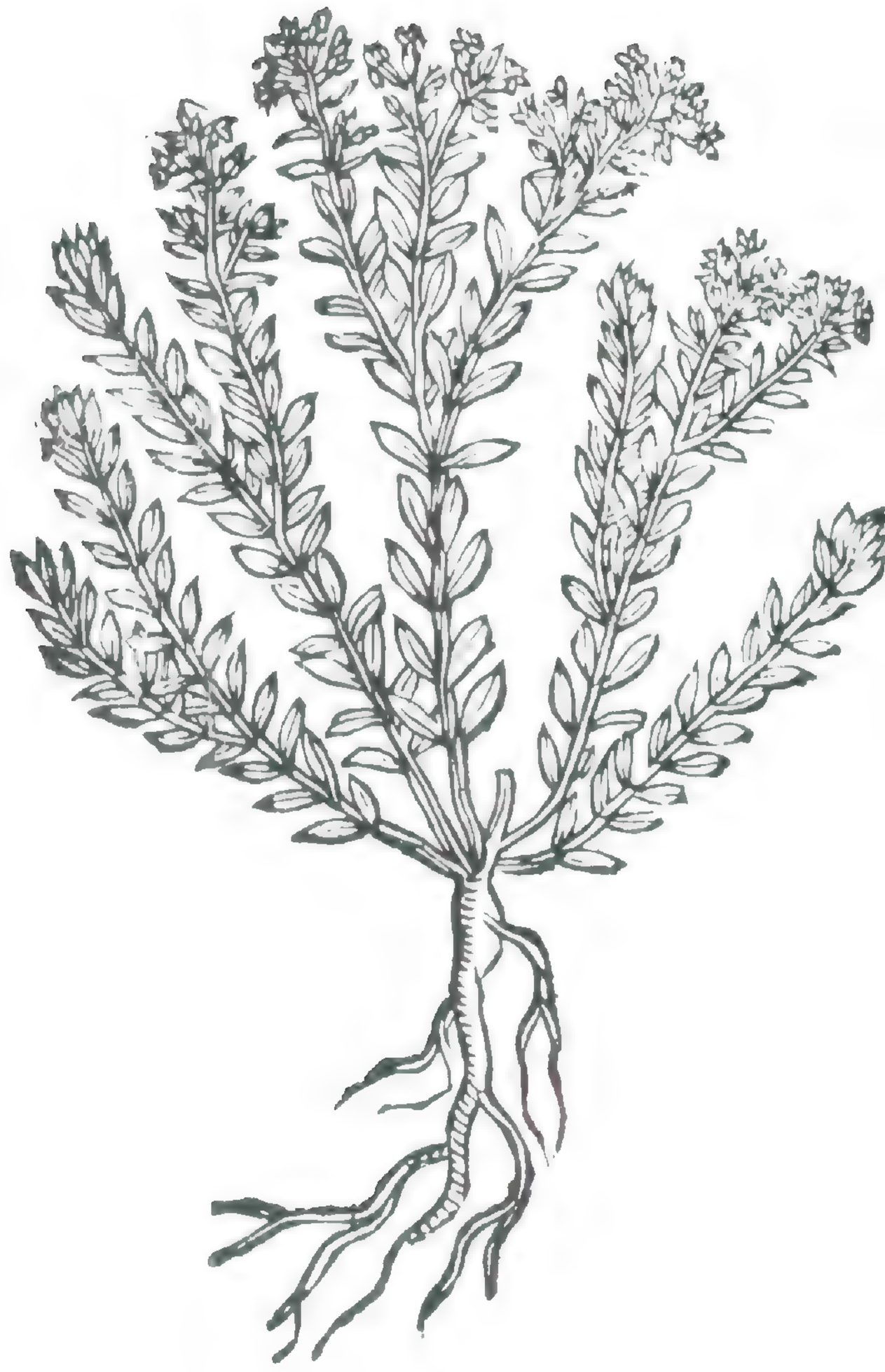
Watering the spring flowering bulb beds can be done if the ground is not yet frozen, but dry. Bring some bulbs inside to pot for midwinter blooms. New house plants may be rooted in pots of sand, Terra-lite or perlite. Repotting, fertilizer, watering, and regular care will keep an indoor garden growing well all winter.

Fall is the best time to fertilize the lawn. Established trees and shrubs can be fertilized now, too. Shrubs that are not spring flowering should be pruned and trimmed and the old wood cut from barberry, mock orange, and spirea. The root suckers should be cut from lilacs.

Cut back the chrysanthemums and other perennials after several hard frosts, and dig up annual beds. Dahlia roots should be dug and stored now, too.

Save the evergreen and holly trimmings for fresh holiday decorations. Collecting acorns, pine cones, sweet gum balls, buckeyes, and many other natural materials for decoration and other projects can add extra pleasure to being outdoors these late fall days.

Gardening tools will work better for you next spring if they are cleaned and oiled now before their winter rest. And your winter outdoor watching will be improved by the addition of bird feeders containing suet, seeds, raisins, apples, peanut butter, and meat scraps to a favorite garden spot. When you provide more than one feeder, you probably won't resent the squirrels' eating more than their share!



The Sweet Ground Pine

Carla Lange

THE COVER ILLUSTRATION of this issue of the *Bulletin* is a copy of an illustration of the sweet ground pine taken from John Parkinson's *Theatrum Botanicum*, published in London in 1640.

The sweet ground pine is a small herbaceous plant with white slender branches and small long leaves; it has a resinous scent and many flowers of a pale yellow color at the top of the branches. It flowers and sheds its seeds in the summer.

This plant, *Ajuga chamaepitys*, is a member of the mint family and a close relative of the ajuga or bugleweed often used as a ground cover. It should not be confused with those plants of the genus *Lycopodium* which are club mosses with the similar common name, ground pine.

As to the "Vertues" of this plant, Parkinson states: "It is especially good for all obstructions of the liver and spleene, for it clenseth

the grosse impure blood, and expelleth that which is congealed. It is as powerful and effectuall also in all the paines and diseases of the joynts, as gouts, crampes, palsies, sciatica and aches. The same is also an especiall good helpe for the jaundice, and also for those that have any griping paines in the belly or joynts. It helpeth also all diseases of the braine, proceeding from cold and flegmaticke humors and distillations, as also for the falling sicknesse."

In the middle of the last century, the ground pine was used as an ingredient for the so-called Portland Powder, a medicine which gained general reputation as a cure for the gout. This powder was named after the Duke of Portland who got so much relief from it that he had the formula printed. It was originally brought to him by friends from Switzerland. However, eventually the Portland Powder ceased to be used to any great extent since physicians became aware of the fact that it caused certain disagreeable side effects.

The ground pine was cultivated in England by Parkinson himself and is now growing in many gardens, as well as on waysides and in fields. Its original habitat is the Mediterranean countries, but it also grows in warmer climates of central Europe and is quite commonly found in vineyards as well as on dry hills and high meadows. It was cultivated and introduced in France, southern England, southern Belgium and central Germany as well as in Poland, primarily for its medicinal values. According to an old legend, it should be picked before sun-up at the rising of the new moon at the end of May or in June to be most effective.

The sweet ground pine, an annual or short-lived perennial, is also an excellent ground cover plant, and will form a thick carpet of foliage that ultimately will exclude weeds. It does equally well in the hot sun and in shady spots. It can be planted under trees, where grass will not grow and, in the wintertime, will brighten an otherwise cheerless landscape. □

Fall Chrysanthemum Show

Leroy Fisher

IN PREPARATION FOR our fall Chrysanthemum Show we introduced several techniques new to the Missouri Botanical Garden. These techniques are not new to the commercial industry but have been in use now for many years. In fact, well over twenty-five years ago plant breeders and scientists discovered that if night darkness was interrupted by a short period of light, many plants would fail to flower. For example, the soybean and later the chrysanthemum were tested under the same conditions with the same results. The plants would continue to grow during winter if they were lighted through the night at different intervals. Horticulturists watched the growth habits and waited until they grew to the desired height, then discontinued the artificial light; and the plants budded and bloomed just as they would have normally in the late fall.

Just the reverse can be accomplished by shortening the daylight period, necessary during our long summer days. Plants shaded in early afternoon until the next morning can be brought into bloom just as in the autumn.

With these two methods the modern chrysanthemum and poinsettia growers can produce commercial crops all year long, season after season.

We are using black polyethylene plastic sheeting instead of the customary black cloth to shade the plants. With modern cooling facilities, heat build-up under the plastic is no longer a problem. Heat, by the way, will also act as a bud retardent. We have selected varieties that do not require our lights or shading for any great length of time (three hours a night is the maximum).

Claude Johnston

utomatic watering and fertilizing is improving both the efficiency and the quality plants being grown for the flower shows.

Along with these two tools we have also been experimenting ith a soil-less mix. Again, this is not new in any way to the flori-lture industry. We had the assistance of Alfred Saxdal, who intro-uced me to a very large mum grower in the area, Dennis Volas reenhouses. With his kind help, we were able to come up with a mix hich is a modification of one Mr. Volas has used for years with eat success.

Because we have also switched from clay pots to plastic on our ajor show crops, we had to substitute vermiculite, which is a prime gredient in the Volas mix, with perlite. This will give us a better ained mix, which is needed since our plastic pots do not absorb oisture as clay pots would.

We have found that plants in this new soil-less mixture have oted far more readily than those in a previous mix which had soil it.

Two other timesaving devices installed are our automatic watering system and a fertilizer injector. With these we are able to reduce considerably the amount of time spent doing this daily task. We are assured, as well, of an exacting amount of water or fertilizer, whichever the case may be.

I'd like to emphasize the importance of these new timesaving methods. When speaking with some of the growers, here and elsewhere in the country, the topics that almost invariably come under discussion, are "labor-saving devices" and "how to cut corners."

Many can tell you how much each inch of space is costing him. There is scarcely a case where you will find a non-productive area. With our plans for increasing the flower displays, both in the Floral Display House and the grounds area, it is important that we utilize these and other labor-saving devices.

Although these are by no means the very latest in new equipment, they are somewhat of a breakthrough for the Garden. Machines and equipment are being developed continually; and I believe that the Garden should be right out in front, testing and utilizing these improvements. If we are to be an educational institution, which should rightly be our role, why should we not help to develop these implements and techniques for the commercial man and the average homeowner. We have the facilities; we have the talent; why not?

Australian Brush Cherry

We now have a new addition to our Floral Display House—*Eugenia paniculata australis* or Australian brush cherry. These tall handsome plants have rich green, small-leaved foliage and planted in large tubs are ideal for use as a backdrop or accent grouping.

They are of the myrtle family *(Myrtaceae)* and the genus is named in honor of Prince Eugene of Savoy (1663-1736), a patron of botany and horticulture in France. These evergreen trees or shrubs are native to Malaya, Australia, Brazil, Chile, etc. In this country they have been introduced and are hardy in California, Florida, and many of our other warmer regions where they are used as an ornamental tree and for clipped hedges.

Claude Johnston

The Australian brush cherry, shown here as a background planting in the new Floral Display House planters, will be handsome additions to the Garden's flower shows.

Claude Johnston

The small insignificant flowers of the Australian brush cherry are followed, in six to eight weeks, by bright red fruits.

The *Eugenia paniculata* or sometimes referred to as *E. myrtifolia*, has a beautiful little white flower and produces a berry which is edible although it is not as good as the related *Eugenia jambos* which is sometimes called rose apple. From this berry, jams and jellies are made.

Commercially this group of plants is of great importance. The people of Zanzibar grow another member of the genus, *Eugenia aromatica*, for the spice clove, which is the unopened flower buds of these plants. The oil extracted from this spice is an essential ingredient in the production of perfume and certain medicines.

Although the Australian brush cherry does well in our warmer regions during the winter months, the plants do require a certain amount of protection from harsh, wintry winds. These plants will do well in any good well-drained soil with an occasional feeding. With the current trend toward more topiary work, eugenias have found their place. Because of their great adaptability to shaping as well as their beautiful flowers and berries, these plants are a welcome addition to our Display House. □

MAN FIRST? MAN LAST?

The Paradox of Human Ecology

Hugh H. Iltis

Dr. Hugh H. Iltis, born in Brno, Moravia, Czechoslovakia, in 1925, received a B.A. from the University of Tennessee in 1948, and an M.A. from Washington University, St. Louis in 1950. He had a fellowship at the Missouri Botanical Garden from 1951-1952, and received his Ph.D. in Systematic Botany in 1952. He is currently Professor of Botany at the University of Wisconsin.

Dr. Iltis main concern is conservation and he writes and speaks eloquently on the subject.

THE UBIQUITOUS CONSERVATION speeches and environmental panels of today are dealing mainly with urgent problems of population, pollution, and crowding. That the priorities are given to these big city, strictly human, homocentric syndromes is obvious and understandable. People die of pollution, people go crazy with crowding, people starve and lay waste the lands through overpopulation.

Hopefully, we may yet solve the *pollution crisis*; we could, I think, clean up our polluted nests—an obvious and necessary achievement. But, if in cleaning up the cities, we forsake the rest of life; if we, in our human preoccupation, let all but corn and cow slide into the abysmal finality of irreversible extinction, then our species indeed will have committed ecological suicide.

Clearly, there is no cause for optimism in the broader *environmental crisis*, for the spectres of ecosystem collapse, of catastrophic extinctions of most living animal species, and a vast number of plant species, are on the horizon.

According to Talbot (*BioScience*, March 15, 1970), 3% of the world's mammals, not counting such pre-historic wonders as the

Irish elk or the mammoth, became extinct in historic times, and most of them during the past 50 years! Today, 10% to 12% can be considered endangered, extrapolating from the conservative 8% of species and subspecies listed as imperiled in the *Red Data Book for Mammals* of the International Union for the Conservation of Nature. Perhaps 130 of the 400 United States mammal taxa are believed to be threatened with extinction. Birds are faring no better! Dillon Ripley, of the Smithsonian Institution, recently estimated that a majority of animal species will be extinct by the year 2000! And Kenneth Boulding suggests that, with the present rate of human reproduction, in another generation it may be economically impossible to maintain any animals, except domesticated ones, outside of zoos. Those are the grim prospects that economic, political, or evolutionary optimists should be confronted with.

Butterfly and wild flower, mountain lion and caribou, blue whale and pelican, coral reef and prairie land—who shall speak for you? My grandchild may need to know you, to see and smell you, to hear and feel you, to be alive,—bright and happy!

Yet, among all the many programs of the recent "Teach-ins" at the University of Michigan and at Northwestern University and 1000 other campuses, there were few to speak for the wild environment, for nature, for a *Morpho* butterfly in a Peruvian valley, for a timber wolf chasing caribou in Alaska.

This lack of concern is understandable, because man now occupies every bit of the earth and, like a dictator, controls or could control, if he wished, every living thing. As some see it, except for a few primitive tribes—"Man has . . . broken contact almost entirely with the ecological universe that existed before his culture developed. He no longer occupies ecological niches; he makes them."*

But have our genes ceased to need the environment that shaped them? If we destroy ecosystems and species with abandon,—ecosystems to which we are adapted, species whose values we do not yet know, and cannot predict—we surely do it at our own peril.

Thus, the lack of focus on the natural environment, on the wild animals and plants, on the woods and streams, is frightening.

*G. L. Stebbins, Saturday Review, March 1970.

Paul A. Kohl

Who defends wilderness, the natural, unspoiled environment? Who defends the environment in which we evolved, and which we still may need in all its purity? Except for a vociferous but ineffective minority, hardly anyone!

How can we rationalize preservation of wild lands in a man-centered world?

The ultimate question one has to ask is this: Shall man come first, always first, at the expense of other life? And is this really first? In the short run, this may be expedient; in the long run, impossible.

Not until man places man second, or, to be more precise, not until man accepts his dependency upon, and puts himself in place

as part of nature, not until then does man put man first! This is the great paradox of human ecology. Not until man sees the light and submits gracefully, not until he moderates the homocentric part of himself; not until man accepts the primacy of the beauty, diversity, and integrity of nature, not until he limits his domination and his numbers, and places equally great value on the preservation of the environment and on his own life, is there hope that man will survive.

If we are to usher in an Age of Ecologic Reason, we must accept the certainty of a radical economic and political restructuring as well as ethical and cultural restructuring of society. No more expanding economics. No more expanding agricultures. No more expanding populations. No new unnecessary dams. No new superfluous industries. No new destructive subdivisions. We must stop and limit ourselves, now.

Let the archaic power structures of the technologically intoxicated cultures of the USA, USSR, Japan, and others, listen and listen well to the winds of change:

The earth and the web of life come first,
man comes second;
profits and "progress" come last.

Man now is responsible for every wolf, as well as for every child, for prairie and ocean as well as for every field.

Henceforth the laws to govern man must be the laws of ecology, not the laws of a self-destructive *laissez-faire* economics. And what the laws of ecology say is that we, we fancy apes, are forever related to, forever responsible for this clean air, for this green, flower-decked, and fragile earth.

Indeed, what ecology teaches us, what it implores us to learn, is that all things, living or dead, including man, are interrelated within the web of life. This must be the foundation of our new ethics.

If you love your children, if you wish them to be happy, love your earth with tender care and pass it on to them diverse and beautiful, so that they, 10,000 years hence, may live in a universe still diverse and beautiful, and still find joy and wonder in being alive.

If we survive, that is . . . if we survive. □

BOXWOOD: A Magnificent Enthusiasm

Mary A. Gamble

Mary A. Gamble, past president and longtime member of the St. Louis Herb Society and chairman of its boxwood study group, is a free lance writer who often contributes to the Bulletin.

In preface and appreciation . . .

Dr. Edgar Anderson will be remembered for many things, not the least of which was his enthusiasm for and specific contribution to boxwood. This latter, which will be described in his own words, has been noted by Dr. J. T. Baldwin, Jr., of the College of William and Mary at Williamsburg, Virginia, as "probably the most significant addition in recent years to the germ plasm of Buxus sempervirens *in the U.S.."*

Dr. Anderson's enthusiasm was infectious. Undoubtedly he had what some perceptive fellow enthusiast long ago dubbed "boxwood fever." This writer caught the fever from Dr. Anderson some two years before his death on June 18, 1969. I had talked boxwood with him many times, but never seriously until one day when I said, "Dr. Anderson, I'd like to do a study of boxwood; will you help me?" "Wonderful," he said; and "Certainly." But characteristically his help did not begin with himself and what he *had contributed to* Buxus, *nor did it include facts and figures.*

Dr. Anderson never gave *you the answers; he simply pointed you in the right direction and the distance you went was entirely up to you. His first advice to me was, "Write Dr. Baldwin at William and Mary; he's the great American authority on boxwood." Dr. Baldwin exhibited the same courtesy, generosity, and sound knowledge I continue to encounter with every boxwood authority consulted.*

Every time I saw Dr. Anderson over the next year and a half (and this was often due to our mutual membership in the St. Louis Herb Society, of which he was inspiration and cofounder) there

was an answer to an old question to report and new questions to pose. He introduced me to the American Boxwood Society (of which he was a charter and honorary life member) and its authoritative Bulletin; *to boxwood authorities throughout the country; to many of the men who had worked with him on boxwood at the Missouri Botanical Garden and its Arboretum at Gray Summit, Mo. Most of the latter I knew through the horticultural activities of the St. Louis Herb Society; now I learned about boxwood from them. And I found that they, too, had boxwood fever.*

The boxwood study which began under the aegis of Dr. Anderson continues. It has grown into a study group of the St. Louis Herb Society and now includes 30 of its members. Its objectives are to learn more and more about boxwood; to learn which species and varieties are hardy in our area and, through this knowledge, to encourage more St. Louisans to add the beauty of Buxus *to their gardens. In short, to spread the fever!*

Dr. Anderson was one of the world's great authorities on boxwood. He belonged to the species he called "boxwood people." He admired and shared what he once described to me as their essential simplicity and gentility. He held them in respect and affection which was returned in full measure. It has been proposed that a Boxwood Garden at Shaw's Garden would be a fitting testimonial to Dr. Anderson's unique position in the world of Buxus. *The first steps have been taken toward the creation of such a garden. When the suggestion for the garden was presented to Dr. David M. Gates, Director, he replied that he was "extremely pleased by the interest shown in developing a boxwood garden on the grounds. This development fits into our over-all improvement plans for the next few years and will serve as a fitting tribute to Dr. Edgar Anderson. The Garden intends to work closely with members of the St. Louis Herb Society boxwood study group to assure the completion of the project."*

The first plants destined for the Anderson Memorial Boxwood Garden are growing now in a nursery area at Shaw's Garden; members of the study group are continuing to test various varieties for hardiness in St. Louis. It is their hope that the future boxwood garden will provide an area of beauty, study and repose where former students, associates, and admirers of Edgar Anderson can remember him in the context of one of his creative botanical efforts;

The late Dr. Edgar Anderson at the Gray Summit Arboretum in 1963 studies the plant which he considered the star of his Balkan collection, *Buxus sempervirens* "Agram". When re-visited in late winter 1969, "Agram" measured 105 inches in height and 44 inches in diameter; its leaves were a dark lustrous green; it had two central leaders. Dr. Anderson commented that "the whole tree has an upward look to its growth."

where visitors can learn of this one phase of this remarkable man; and where members of the study group can testify to their lasting interest in and increasing knowledge of this plant he knew and loved.

THE ENTHUSIASM for boxwood, or *Buxus*, is not new; the plant is a living legend. It has been known to man for more than 3,000 years of recorded history, and its existence has been verified—through fossilized leaf skeletons—for eons of prehistoric time. It has enhanced man's gardens from the time he branched beyond the strictly utilitarian to add the grace notes of beauty and pleasure. The American Boxwood Society calls it "man's oldest garden ornamental." It has that rare quality, charm.

Boxwood takes many forms: columnar, pyramidal, globular, prostrate, weeping. The size of a mature plant depends upon species and variety. Among the smallest is *Buxus microphylla* var. *japonica;* the largest is *Buxus balearica,* also called "Minorca" or "Turkey" box; it was the boxwood of commerce.

The fascination of boxwood begins with its superbly elegant appearance. No matter the species or variety, its close-growing leaves are a vibrant green with a suggestion of mystery in their depths. The shades range from bright, light green to deepest emerald, the casts from blue to bronze. Some are variegated, edged with cream, yellow, white, or gold. All have the patina and depth of fine Danish enamel.

The odor of boxwood is sharp, distinctive, pungent. Some like it, some don't. Queen Anne of England detested it. After she came to the throne in 1702 she wasted little time in having all *Buxus* removed from her palace grounds, leaving hers possibly the only stately gardens of 18th century England to lack this aristocrat of plants. John Gerard, famous 17th century English herbarist, considered it an "evil and loathesome smell"; John Parkinson, England's first great natural historian and horticulturist, called it "that ill sent." Thomas Jefferson disliked it.

On the other hand, it has been likened to the aroma of fine tobacco and called "toxy." The 16th and 17th century English, as they followed Lord Bacon's admonition to make their gardens pleasing to both the senses of sight and smell, planted boxwood not only for its evergreen beauty but also for its individual, biting scent. To be appreciated fully, the pungent odor of boxwood should be

inhaled deeply after a rain, in the full sun, and again by moonlight. Then only can one sense the nuances of potency which are a part of the plant's evocative and fascinating perfume.

The wood of box is a delicate, greenish-yellow color. It is hard; it has a fine, uniform grain; it is heavy, the only European wood which will not float in water. It does not split easily and can be handled almost like ivory. All of these physical characteristics led to its wide historic use in wood crafts and arts. The ancient Egyptians made combs of it, the ancient Phoenicians oarlocks. It was the wood preferred by the artists who engraved the woodcuts which illustrated the first printed books and herbals.

It was used to shape woodwind musical instruments described as notable for "purity and sweetness of tone". John Gerard wrote it was "fit for dagger haftes." And the artists and artisans of ancient and medieval times used boxwood to carve chessmen and checkers, statuettes and medallions, measuring rules and mathematical instruments, nutcrackers and cutlery handles. Cabinet makers used the wood, elegantly pale like old ivory, for inlay, marquetry, and ornamentation. In modern times when the Industrial Revolution began in England with the development of mechanical power for that nation's great textile plants, boxwood shuttles were used for the power looms. This was a tragedy for the plant; the demand for boxwood was so great that the available supply was virtually exhausted, the groves denuded; it was boxwood's commercial swansong.

In classical Greece and Rome, centuries before England's power looms began to whir, the wood of the box tree had been chosen over all others to fashion the exquisite small boxes in which the Greeks and Romans carried their perfumed cosmetics. And, as usual, the Greeks had a word for it. They called the wood from which their treasured boxes were made *pyxos*, or Greek for box. The Romans called it *buxus*, or Latin for box. The Angles and the Saxons, as they evolved the English tongue, shortened the Latin *buxus* to box, and so, *Buxus*, the generic name of boxwood stems from the beauty and quality inherent in its wood. *Sempervirens*, the prevailing species of the western world, had its name, which comes from the Latin for "evergreen," bestowed by Linneaus. And throughout the millenia man has made "the green bough" a symbol of the everlasting, the eternal.

Boxwood, in its serene, ageless manner, has had time to acquire

many legends and customs which, like moss on an old stone, make it more interesting. Many are linked with its evergreen foliage and the attendant association with immortality. The Romans lined coffins with boxwood; in parts of England today mourners cast sprigs of boxwood into open graves. In the Low Countries of Europe branches of boxwood, on this occasion called "palms", are blessed and carried in Palm Sunday processions. A sprig of such a palm placed at a doorway insures a home against evil throughout the coming year.

In ancient and medieval times when belief in the supernatural was rampant, boxwood was thought to have the power to exorcise ghosts; today, in some historic boxwood gardens, ghosts are said to still walk. But boxwood, with its aura of rectitude, keeps their secrets.

In Germany a box often was chosen for the Christmas tree, and a legend has it that the first lights twinkled, in the 17th century, on a tree of box. In England the tradition grew of taking down the "boughs of holly" and other decorative Christmas greens on Epiphany, January 6, and replacing them with box. Robert Herrick, 17th century English poet, wrote these words to mark the custom:

"Down with the Rosemary and Bays,
Down with the Mistletoe;
Instead of Holly now upraise
The Greener Box for show."

This pleasant ceremony crossed the Atlantic with the colonists; it would be nice to see it expanded.

Boxwood is mentioned in the Bible. My favorite quotation is from Isaiah, 61:13: "The glory of Lebanon shall come unto thee, the fir tree, the pine tree and the box together, to beautify the place of my sanctuary."

Like many other plants, boxwood has a sinister side. The whole plant is slightly poisonous due to the alkaloid buxine in its leaves and bark. A drug of the same name is extracted from them and used as a narcotic sedative and purgative, calling to mind the folk saying that "what could kill could cure." John M. Kingsbury in his book *Deadly Harvest* (Holt, Rinehart & Winston, Inc.) writes: "Box is the most important (of the hedge plants) as a poisonous plant . . . Many kinds of animals have been killed by clippings from box hedges or single specimen plants. Apparently only a small amount of leaves is required to produce death. Symptoms and injuries are those associ-

This beautiful planting of *Buxus sempervirens* grows on a knoll near the Arboretum entrance at Gray Summit. The plants are in full sun and are sheltered somewhat from winds by the topography! The perfectly drained site is rocky; one of the men who helped with the planting recalls that pickaxes were needed to dig holes in the limestone. These plants are descendants of boxwood which has thrived at Ste. Genevieve, Missouri for close to two centuries.

ated with irritation in the digestive system, often severe enough to result in blood passed with the feces." Reassuring is the fact that livestock losses are relatively rare, suggesting that animals share Queen Anne's aversion to the plant's odor as well as rejecting its bitter taste.

Boxwood, "man's oldest garden ornamental", has, through history, graced untold great gardens. The ancient Greeks and Romans used it lavishly; it bordered Pliny's garden in 1st century Rome. The Roman passion for topiary—the garden art of clipping form and shape out of living green—found its most expert expression in the close-growing, small-leaved foliage of box. Every patrician Roman garden had its *topiarius* who sought to out-do his rivals in the gardens of the villas on the neighboring hills. The Romans took topiary with them to England; over the centuries it traveled from the gardens of Italy to those of Portugal, Spain, Holland. It came to the New World with the European settlers who found it a touch of home.

The Moors in Spain often hedged their harem gardens with box, as fine a testimonial to the density of its foliage as could be asked. Boxwood was a part of many medieval monastery gardens. It was used to define the parterres and to provide the background hedges of the "pleasure" gardens developed during the Renaissance in Italy, France and England.

Cardinal Wolsey had it planted in the formal garden which he developed at Hampton Court Palace for Henry VIII. Lenotre, greatest landscape architect of his day and creator of Louis XIV's Versailles gardens, used boxwood to help express two of his basic ideas: one, that a garden should have areas of privacy; and another, that it should have vistas. He also planted boxwood in the Vatican gardens which he designed.

But it is a mistake to picture boxwood as growing only in "grand" gardens. It was as much at home in the Puritan's small, front-yard "company" gardens in mercantile New England as it was in the plantation gardens of the southern colonies.

And today boxwood is as much a part of the 20th century as it was of the 1st, and appears as suited to modern or contemporary homes and gardens as to the period or traditional. It may be used informally or formally; and in every treatment it retains its consummate elegance, its sense of heritage. Boxwood, to a garden, is what a fine antique is to a home.

Boxwood is not a static plant. One cannot say of it, as is reputed to have been said of redwood, "once you have seen one redwood, you have seen them all." Dr. Baldwin writes of *Buxus sempervirens:* "The species is extremely variable. The habit may be fastigiate, prostrate, weeping, shrubby, or arboreal. The leaves may be narrow to broad, and rounded, notched or apiculate. They may be flat, bullate, or twisted. They might remain dark green when exposed to the winter sun or become reddish or brownish when the cholorophylls are broken down and the carotenoid pigments allowed to show up. They may be variegated with flecks of white or yellow or have patterns of white or silver or gold against green."

Boxwood is native to Central and East Asia, North Africa, and Southern Europe; it grows also to a limited extent in western India and Central America. Carolus Linnaeus, the great 18th century Swedish botanist who established the binomial system of plant nomenclature assigning to each plant a generic and a specific name,

recognized only one species of boxwood: *Buxus sempervirens*, with two varieties, var. *arborescens*, a tree-like type, and var. *suffruticosa*, a dwarf type. Today there are some 30 species recognized generally, but, practically speaking, we in St. Louis and the Midwest, need concern ourselves with only two: *Buxus sempervirens* and *Buxus microphylla*.

The origin of boxwood in England is disputed. Dr. Anderson thought there was strong reason to believe that boxwood arrived in England with the Druids, a pagan people who revered trees, at the time of that island's stone age. This is conjecture, but it is fact that the Romans, in their 500-year occupation of Britain, beginning in 55 B.C., brought boxwood from the continent and planted it in their gardens, complete with topiary. Today in England boxwood grows wild only on Box Hill in Surrey, not too far from Colchester where the Romans first settled.

The first record of boxwood planting in America is at the manor of Nathaniel Sylvester of Long Island in 1652. The Virginia planters were shipping plants from England to Jamestown as early as 1621 and many individuals, making the tortuous 10-week crossing of the Atlantic, carried slips of various European plants with them. Surely, boxwood was included. Dr. Baldwin comments: "European immigrants to Colonial America . . . introduced clones from the Continent as well as from the British Isles. In later years nurseries regularly imported box, especially from Holland . . . There are today hundreds of clones (a group of plants developed from an individual plant by various types of asexual reproduction) of *Buxus sempervirens*. The fast-growing kinds became known as 'American Box'; the slow-growing var. *suffruticosa* as 'English Box' and var. *arborescens* as 'Tree box'."

The above has led to considerable and continuing confusion; but let's forget that and concentrate on the species important to us. Let's heed the advice of Mr. Clarence Barbre, well-known St. Louis nurseryman and respected boxwood enthusiast, who says, "Don't get entangled in boxwood species; put your time and effort on what grows, here."

What grows here is, first, *Buxus sempervirens* or common box. It takes many shapes. It may be a globular or wide-spreading shrub; or it may be a small columnar or pyramidal tree which, under optimum conditions, may reach 25 feet, although 10 to 15 feet is more

likely. Its leaves are a lustrous green on top and bottom and are broadest at or below the middle. With exceptions, it grows at a rate of 6 inches or more a year; and a plant can be maintained at a desired height for a long time; "at least 25 years," says Mr. Paul A. Kohl, for many years floriculturist at Shaw's Garden. There are many varieties, some named, more anonymous; many are hardy here.

One group of *Buxus sempervirens* of special interest to St. Louisans and Midwesterners is the Balkan strain developed by Dr. Edgar Anderson following one of the intuitive and deductive botanical hunches which were his genius. He described his trip to the Balkans and the resultant boxwood in an article in *The American Boxwood Society Bulletin* (Vol. 2, No. 3, 1963). We are grateful for permission to reprint the following article in full not only because it tells delightfully the story of one of Dr. Anderson's experiments in hybrid vigor but also because, as one of his few known writings on *Buxus,* it has permanent significance for all students of the plant.

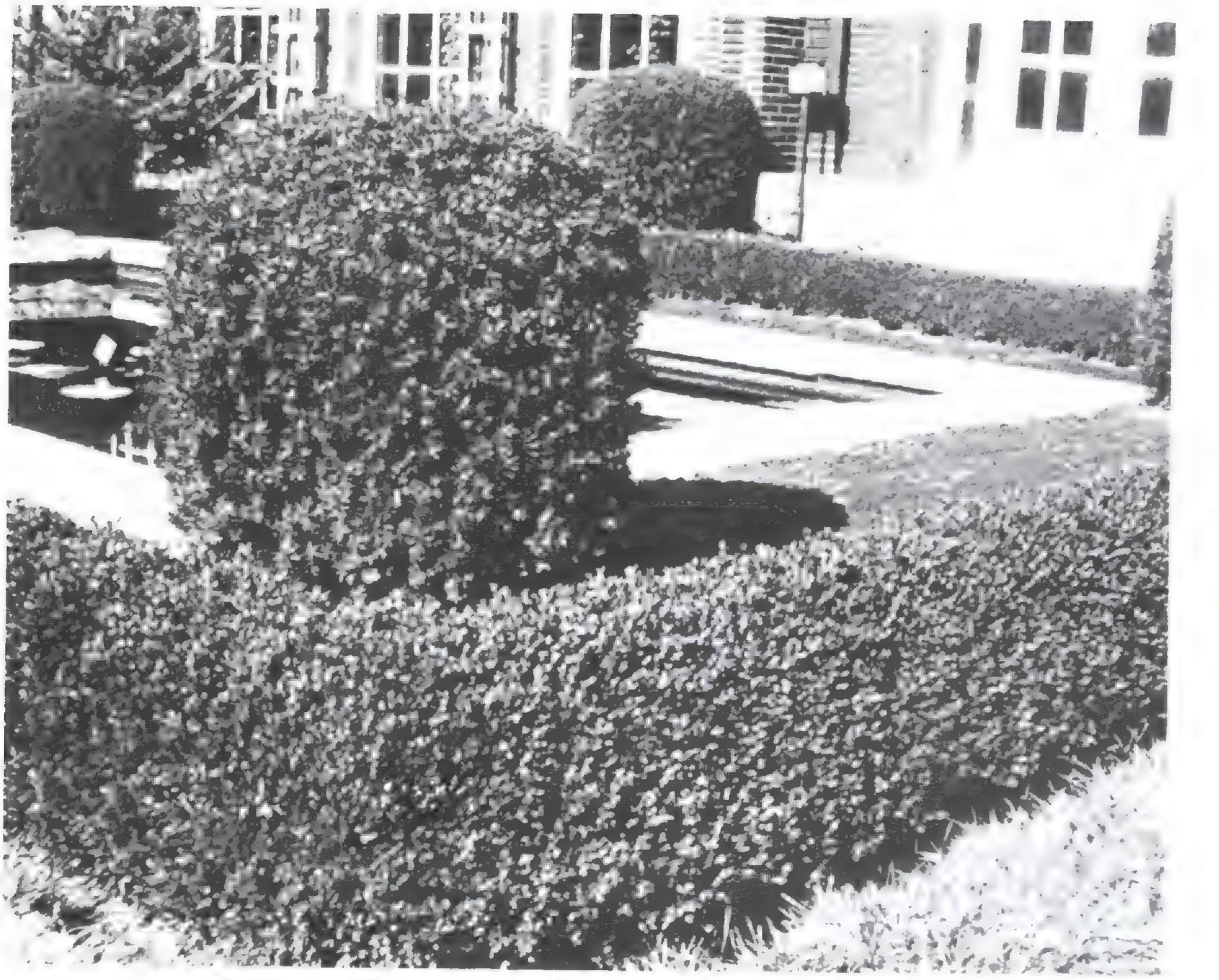
Collecting Boxwood in the Balkans

by Edgar Anderson

My Arnold Arboretum trip to the Balkans in the late summer and early autumn of 1934 was an attempt to get strains of holly, ivy, yew, and boxwood which would fit the difficult climate of the eastern United States, hot and dry in the summer, cold in winter with drying winds, late frosts following deceptive warm spells in the spring, bright winter sunshine sometimes in extremely cold weather so that leaves are apt to be damaged.

For these reasons I went to the Balkans since they have somewhat the position in Europe that the Ozarks do in the United States. Just as our Great Plains are a vast bowl of cold air in winter and of hot air in summer so the Russian steppes (which extend eastward to the very outskirts of Bucharest) are a similar bowl which slops over now and then towards the Balkans and makes a difficult, chancy climate there, much like our own. It is not quite so difficult for plant life as ours since the presence of high mountains brings dews at night and cooler night air even in very hot weather.

Boxwoods are not evenly distributed all over Europe; there is a northern area where they are found and then another separate area at the south. At the Royal Botanic Garden at Kew and at the Botanical Garden in Belgrade by consultation and study in the her-



A close-clipped hedge of *Buxus microphylla* var. *koreana* surrounds the lily pool which fronts the Linnaean House at the Missouri Botanical Garden. It grows in full sun, which is one of the reasons why this Asian species of *Buxus* is so popular. Like all the *microphylla*, it bronzes in the winter sun.

barium I found that the northernmost extension of this southern strain was just outside of Skopelie in the valley of the Vardar river, in the Madedonian edge of Yugoslavia. The government gave me a courier to travel with me and help in buying tickets, reporting to the police, carrying luggage and generally serving as a companion. He was a White Russian and spoke almost no English but he spoke fluent German and we communicated in that language.

Our directions had been to go to a monastery in the outskirts of Skopelie and that there we would find boxwood in quantity. My memory is that we took some sort of conveyance out to the bridge over either the Vardar or one of its tributaries and then proceeded afoot along the pathway which led to the unpretentious little white-washed monastery. The river bed, broad and gravelly, was at one side and the mountains from which the stream rose loomed ahead,

dry and rocky with some shrubs on the lower slopes and here and there an occasional battered tree. The records of the monastery showed that up to a few hundred years ago the mountain was largely covered with a beechwood forest, from which the monastery had drawn a substantial part of its revenue. Over-cutting and over-grazing had destroyed the forest. Heavy erosion had done the rest and much of the mountain was down to the bare rock. Goats, which were still everywhere, were the worst offenders and when we came to the acres and acres of boxwood they too were nibbled, sometimes almost down to the ground, seldom or never were they over shoulder high. While the boxwoods grew in great abundance there were other characteristic evergreen shrubs in with them; big bushy thymes and rosemarys I remember in particular.

At the time of our visit the seeds were already ripe and had been scattered by the browsing goats. We got down on our hands and knees and picked up the shiny black seeds (a little smaller than apple seeds) from underneath the bushes. It was slow work but we eventually got a hundred or so. We also took cuttings to send back airmail to my collaborators in England and made herbarium specimens of the boxwoods and other shrubs.

The bushes had been so heavily grazed it was difficult to tell anything about their growth habit but from the stubs that were left it was easy to see that there was much more variation from bush to bush than in the boxwoods which grew wild (or apparently so) at Box Hill in the south of England. They varied conspicuously in leaf size and in leaf shape and in the amount of bluish bloom on the leaves.

The first Balkan boxwoods to be distributed in the United States were raised from these seeds collected in among the bushes of the goat pasture near the monastery. A year after I returned to Harvard University and the Arnold Arboretum where my seeds and cuttings were coming on safely, I went back to the Missouri Botanical Garden in St. Louis and it was from St. Louis that the largest number of boxwoods were introduced. I got in touch by mail with the acquaintances I had made in the Yugoslav forest service and we imported a pound or so of boxwood seed which was raised at the Gray Summit Arboretum of the Missouri Botanical Garden. Eventually a fairly complete set of more than a hundred different bushes was sent as cuttings under number to Henry Hohman of Kingsville,

Maryland, for distribution to the Orland E. White Research Arboretum at Blandy Farm and to the box collection at the College of William and Mary. They are extremely variable like the population from which they came and among them are certainly going to be found the hardiest in existence. They are doubly hardy because of the area they came from, being drought resistant as well as cold resistant. They vary a great deal in branching habit as well as in leaf shape and color. One dwarfish lowgrowing form has been found among them and one gracefully columnar form. As a group they are rampant and a little coarse but they have great ability to do well under exacting conditions.

The "gracefully columnar form" to which Dr. Anderson refers is *Buxus sempervirens* "Agram," now growing on the edge of a wooded area at Gray Summit; man and plant are shown in the 1963 photograph, page 21. The "dwarfish lowgrowing form" has been lost track of; if any reader knows where a plant may be growing, we will be deeply grateful for that information.

Every *Buxus sempervirens* growing on the grounds of Shaw's Garden today is a representative of the Balkan strain, souvenirs of Dr. Anderson's Balkan journey.

Although this article is dedicated to those *Buxus* hardy in the St. Louis area, we feel there must be one exception: *Buxus sempervirens* var. *suffruticosa*. This historic and beautiful variety is not reliably hardy here; but it can be and has been grown successfully over many years where a favorable microclimate exists or has been provided. It requires shelter from winter winds and some added protection from severe cold. It is the box called dwarf or edging but under favorable conditions and over a long span of time it can reach ten feet or more, increasing in height at the rate of about a half inch per year. Its exquisite small oval leaves have the sheen of a female hummingbird's breast; each has a notch, sometimes distinct, often barely discernible. It is the jewel of boxwoods. Realistically, it is not for extensive St. Louis plantings; but it is difficult to envision a boxwood garden as complete without it.

The second species of *Buxus* of practical interest to us is the Asiatic *B. microphylla* whose natural range is China, Korea, Taiwan, and Japan. It owes its specific name to its comparatively small leaves.

Buxus microphylla var. *japonica* was introduced to this country about 1860.

Buxus microphylla var. *koreana*, probably best-known of the group, was brought to the United States by Dr. Earnest H. Wilson and introduced in 1919. Because of its hardiness and its acceptance of full sun, a quality rare in *Buxus*, it enjoyed immediate popularity. Its wide choice for hedging, with resultant severe clipping, has led to many descriptions of it as "reaching some 2 feet or more." But left to grow at its rate of some 3 inches a year, a 20-year-old plant will reach 5 feet in height and will spread into a globular or pyramidal shrub not unlike *Buxus sempervirens*.

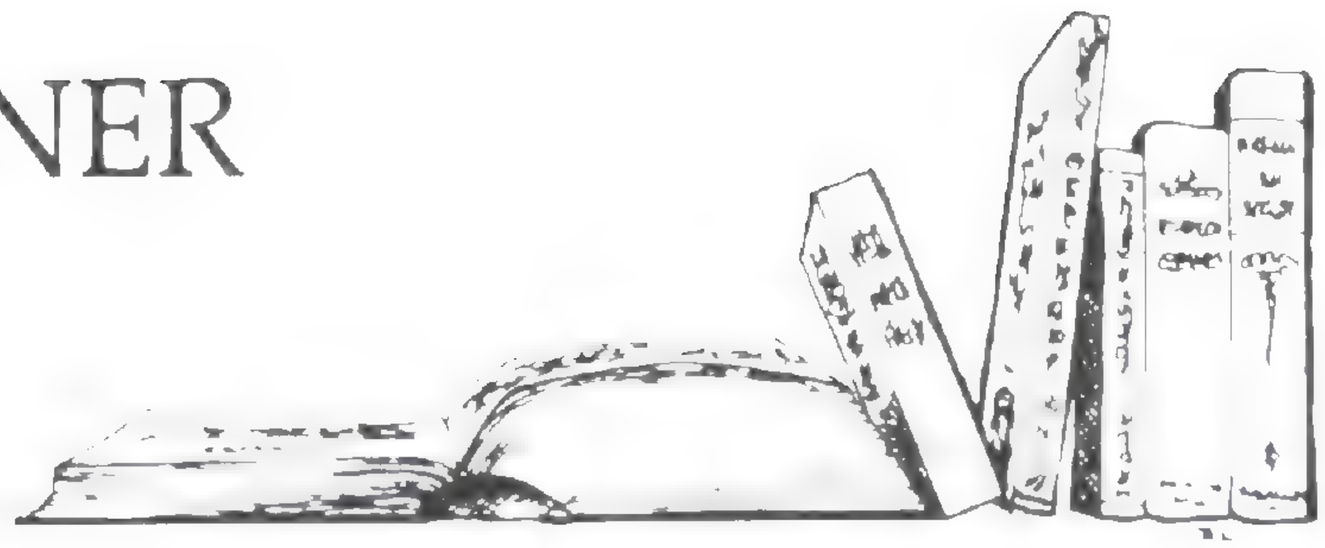
A third member of the group is *Buxus microphylla* var. *sinica*, a variety from China. Its leaves are larger than those of var. *koreana* and it has a more upright habit of growth. Generally, the leaves of the *B. microphylla* varieties are a lighter green than those of *B. sempervirens;* they differ further in that they are broader above the middle. And they bronze, to varying degrees, in the winter sun.

Some gardeners find this bronzing trait of *B. microphylla* objectionable. Others, including this writer, look upon it as evidence of the changing seasons, one which contributes to the muted tapestry of winter.

Buxus microphylla shares the variety and individuality of *Buxus sempervirens;* and again, there are numerous varieties suitable for us. Used together the two species provide living proof that the tradition and beauty of box can enrich the gardens of St. Louis as well as those of Tidewater Virginia. □

Note: A succeeding article will deal with the practical aspects of how to grow boxwood in the Midwest.

BOOK CORNER



A review by Duncan M. Porter

Flowering Vines Of The World

by Edwin A. Menninger (Hearthside Press)

IT MAY SEEM STRANGE for the reader to find me reviewing this book, as I am listed as a contributor to it. But since my contribution amounts to about 1/3 of a page in this 410 page tome, I think that I will not be accused of bias toward the book.

Two others associated with the Garden have contributed far more to the excellence of the project than I. That venerable spinologist Lad Cutak has written an excellent account of the *Cactaceae*, plus providing most of the photographs for this prickly family. Dr. John Dwyer has added interesting notes on a number of viny legumes.

Menninger stretches the common definition of vine to include a number of plants that many would class merely as sprawling shrubs or ground covers and trailing or creeping annuals or perennials, but including them does give us an opportunity to discover more about them. Other plants not viny under natural conditions, but trained as climbers by gardeners, also are discussed. In truth, there is no sharp dividing line between herbs and shrubs on the one hand and vines on the other. Some plants even will vary with the ecological conditions under which they are grown and may be shrub, tree, or vine.

The objective of the book "is to present not only the principal vines in cultivation, but also many others that deserve horticultural recognition." Menninger does have a bias toward tropical and subtropical climbers, but this is understandable, considering the author's

long experience as a horticulturist in Florida. Besides, the overwhelming majority of vines are tropical!

The book's emphasis is on vines that normally produce showy flowers. However, the reader expecting information only on angiosperms (flowering plants) will be pleasantly surprised, as *Gnetum* (a gymnosperm) and climbing ferns also are included. The book perhaps should have been titled *A World-wide Compendium of Vining Plants, Flowering or Not.*

The main body of the text consists of descriptions of the plants. These are presented alphabetically by family, and then by genus within each family. The descriptions may simply give an abbreviated discussion of morphology, or they may contain detailed instructions for planting, training, and pruning.

Following a general introduction to the world of vines, the first three chapters cover how they are constructed, what constitutes a vine, and the mechanics of how they climb. In the latter chapter, Menninger categorizes vines as "leaners", such as *Tradescantia* (spiderwort), which have no adaptations or inclinations for climbing; "thorn clingers", like *Rosa* (roses) or *Rubus* (brambles); "weavers", knitting themselves fast to their supports, like *Trachelospermum jasminoides* (Confederate jasmine); "graspers", such as *Parthenocissus* (Virginia creeper) and *Clematis* (virgin's bower) with structural modifications enabling them to grasp a support and hold on; and "rooters", sending their roots around and into supports, like *Hedera* (ivy) and *Campsis radicans* (trumpet vine), a Missouri native which should be more widely cultivated.

The next chapters are devoted to discussions of the usefulness of vines, how they are supported (that is, how to support them in the garden), climbers in the glasshouse, espaliers (not really vines at all), and the most beautiful vines in the world. Menninger admits that, "Any attempt to select the most beautiful flowering climbers in the world is inevitably fraught with difficulties." It also results in a highly selective list. *My* favorite flowering vine is a passionflower *(Passiflora vitifolia)* with scarlet flowers six inches across, seen clambering in the rain forests of Panama, that does not seem to have got into cultivation here as yet. For a favorite native climber, it would be a tossup between species of the white-flowered *Clematis* and the blue *Wisteria*. But the most interesting vine I've ever viewed is the *Ficus pumila* (climbing fig) that adorns the walls of the Gar-

den's Linnaean House and new Growing Center. It's hard for one who climbed a fig tree as a boy to sample the succulent fruits to accept that this large genus of tropical and subtropical trees could have given rise to such a species.

Following the descriptions of the plants is a concluding chapter devoted to the vines left out of the book. Even here, however, the author has not been content with a mere list, but has included much descriptive material. Covered are vines of excessive size, those that are weeds, vines with ornamental foliage, inconspicuously-flowered climbers, those that yield fruit or other crops, horizontal vines, vining and scrambling ferns, climbing palms, climbing aroids, mistletoes and other parasites, gymnospermous vines, climbing bamboos, grasses that climb, and climbing epiphytes. There is probably more information about vines in this book than some readers will care to know!

As the subtitle indicates, Menningers work is truly "An encyclopedia of climbing plants." The text is augmented by 579 photographs and a few line drawings. The color plates are described as "superb" on the jacket blurb, but many in the review copy are not true to form. Despite this, and a $25.00 price, the book will be a welcome addition to the library of any plant lover who can afford it. □

A Review by Marshall R. Crosby

The Illustrated Flora of Illinois

edited by Robert H. Mohlenbrock

(Southern Illinois University Press)

THE AIM OF THE *Illustrated Flora of Illinois* project is to publish a series of books dealing with *all* the plants of that state—from algae, fungi (not always considered plants these days), mosses and liverworts, through the ferns and flowering plants. Each volume will be written by specialists in the various groups of plants. The

general editor for the series is Dr. Robert H. Mohlenbrock of Southern Illinois University at Carbondale, who received his training at the Garden some years ago. An advisory board of five other botanists will aid in co-ordinating the program. The format will be uniform throughout the series, and, most significantly, each species will be illustrated.

The first two volumes to deal with the angiosperms have just been published, a single volume covering the ferns having appeared in 1967. Both were written largely by Dr. Mohlenbrock. They are entitled *Flowering Plants: Flowering Rushes to Rushes* and *Flowering Plants: Lilies to Orchids*. This covers all of the monocots except the grass family and the sedge family. These are large exceptions, and four additional volumes are planned for them. Many, many volumes will be required to cover the remaining flowering plants, the dicots.

The introductory matter in these two volumes does not include comments on the grasses and sedges, since there are so many and since they are such distinct and peculiar plants in themselves. The first volume, *Flowering Rushes to Rushes*, contains an introduction to the morphology of monocots in Illinois, which will be informative for users who know little about botany. A second section in the introduction lists species which might be expected in various natural and distributed habitats. A list of "the rarer species" notes that of the 248 species discussed in these two volumes 63 (25%) are known from three or fewer localities. Some of these are most likely extinct now, like the peculiar *Thismia americana* whose nearest relative occurs in New Zealand and Tasmania. It is encouraging, though, that many of the rare species have been rediscovered in recent years.

Each volume contains a key to all monocot families found in Illinois with proper notations as to which volume treats each. The arrangement of families is not that found in most floras, but it reflects recent work concerning the proper relationships among the various groups.

Each order, family, and genus is briefly described, and a short discussion noting particular features or recent research in the group is usually included. The treatments of each species give the correct Latin name as well as synonyms—different names which have been applied to the same plant—and a brief description of the pertinent features of the plant. The common name, as used in Illinois, the habi-

tat, the entire range, and the range in Illinois are also given for each species. A small map graphically summarizes, county by county, the range in Illinois. A few comments on the plant are usually included to round out the treatment.

Most of the illustrations occupy the full octavo page and include a habit sketch and enlarged details of the flowers and fruits. All but a few of the drawings were prepared by Miriam Wysong Meyer. The illustrations are of high quality throughout, and we hope that this standard can be maintained in succeeding volumes, particularly in those dealing with the cryptogamic groups (mosses, ferns, lichens, liverworts, fungi, and algae).

It is evident that Dr. Mohlenbrock wished the *Illustrated Flora* to be useful and interesting to both amateur and professional botanists. These two volumes represent vigorous hybridization of popular guidebook and technical manual. Amateur and professional alike will appreciate the concise descriptions and fine illustrations. The amateur can ignore the technical discussions and the professional can, generally, forgive some tedious repetition.

One term commonly used by taxonomists, but which is not in common parlance, is found again and again but never defined in these volumes of the *Illustrated Flora*—taxon (pl. taxa): a group of plants recognized as a formal unit at any level in a classification. The word is often used when a botanist does not wish to take a stand on just what rank, species, subspecies, variety, to give a particular group of plants, as for instance, "I believe that all of these plants represent one taxon."

The *Illustrated Flora of Illinois* should prove quite workable across the River in Missouri. A comparison of the first volume, *Flowering Rushes to Rushes*, with the corresponding families in Steyermark's *Flora of Missouri* shows that of the 116 species treated for Illinois, 84 (72%) occur in Missouri. In these same families only 14 species are found in the *Flora of Missouri* but not in the *Illustrated Flora*. □

MISSOURI BOTANICAL GARDEN BULLETIN
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*indicates that an article is illustrated in some fashion.

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Visit Your Missouri Botanical (Shaw's) Garden

The Missouri Botanical Garden's main entrance is at Tower Grove and Flora Place. The Garden is served by both the Sarah (No. 42) and the Southampton (No. 80) city bus lines.

The Missouri Botanical Garden Arboretum—1600 acres—established at Gray Summit, Missouri, in 1926, is open to the public.

The Garden—70 acres—is open every day except Christmas and New Year's. For the main entrance, grounds, Climatron, display greenhouses, and Floral Display House:

May 1 through October 31 . . . . 9:00 a.m. to 6:00 p.m.
November 1 through April 30 9:00 a.m. to 5:00 p.m.
Sundays and Holidays . . . . . 9:00 a.m. to 7:00 p.m.

For Tower Grove House:

May 1 through October 31 . . . . 9:00 a.m. to 5:00 p.m.
November 1 through April 30 10:00 a.m. to 4:00 p.m.

The Display House presents four major shows: November, Chrysanthemums; December, Poinsettias; February, Orchids; April, Spring Flower Show. During the year other shows, competitions, and festivals are sponsored by various garden clubs and flower societies.

Courses in botany and horticulture for adults are conducted by the Garden staff. Children's nature classes are provided free on Saturdays from mid-September to early June. The Pitzman Nature Program is held for children during the summer. The Garden is world famous for its scientific research program. The scientists of the Garden hold teaching appointments on the staff of Washington University.

The Missouri Botanical Garden was established for the public's benefit in 1859 by Henry Shaw. The Garden, a non-profit institution, relies for support solely upon contributions from the public, the Arts and Education Council, and income from the Shaw estate. The Garden receives no city or state tax support.

Support your Garden and take part in Garden activities through the Friends of the Garden. Information may be obtained from the Main Gate or by mail or phone (865-0440).

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